

WORK PLAN FOR MONITORING OF DRINKING WATER WELLS (REVISION 1)

CTS OF ASHEVILLE, INC. SUPERFUND SITE

**235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762**

Prepared for:

**CTS Corporation
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Elkhart, Indiana 46514**

Prepared by:

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AMEC Project 6252-12-0006

August 30, 2012





August 30, 2012

Ms. Samantha Urquhart-Foster
Superfund Remedial and Site Evaluation Branch
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Subject: **Work Plan for Monitoring of Drinking Water Wells, Revision 1**
CTS of Asheville, Inc. Superfund Site
235 Mills Gap Road, Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762
AMEC Project 6252-12-0006

Dear Ms. Urquhart-Foster:

Please find attached the Work Plan for Monitoring of Drinking Water Wells, Revision 1 (Work Plan) for the above-referenced site. AMEC Environment & Infrastructure, Inc. prepared this Work Plan on behalf of CTS Corporation pursuant to the requirement set forth in Section 1.3.3 of the Scope of Work contained in Appendix A of the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study between the United States Environmental Protection Agency (USEPA) Region 4 and CTS Corporation (effective date of January 26, 2012), and in response to USEPA's *Comments on the Work Plan for Monitoring of Drinking Water Wells* letter dated April 25, 2012.

If you have questions regarding this Work Plan, please contact us at (828) 252-8130.

Sincerely,

AMEC Environment & Infrastructure, Inc.


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FIGURE

- 1 Topographic Site Location Map

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LIST OF ACRONYMS

AMEC	AMEC Environment & Infrastructure, Inc.
bgs	below ground surface
FSAP	Field Sampling and Analysis Plan
HASP	Health and Safety Plan
MCL	Maximum Contaminant Level
NCGS	North Carolina Geological Survey
QA/QC	quality assurance/quality control
RI/FS	Remedial Investigation/Feasibility Study
TCE	trichloroethene (also, trichloroethylene)
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

DOCUMENT REVISION LOG

Revision	Date	Description
0	2/24/2012	Initial Issuance
1	8/30/2012	Revisions based on comments received from USEPA in a letter dated April 25, 2012 ("Comments on the Work Plan for Monitoring of Drinking Water Wells").



1.0 INTRODUCTION

This document presents the Work Plan for Monitoring of Drinking Water Wells (Work Plan) associated with the CTS of Asheville, Inc. Superfund Site (Site) located at 235 Mills Gap Road in Asheville, Buncombe County, North Carolina (Figure 1). The activities described in this Work Plan will be performed pursuant to the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (Settlement Agreement) between the United States Environmental Protection Agency (USEPA) Region 4 and CTS Corporation (CTS, Respondent). This Work Plan describes the proposed sampling and analysis activities that will be undertaken to monitor drinking water quality from water supply wells and springs located within a one-mile radius of the former plant at the Site.

1.1 SITE DESCRIPTION

The property containing the former plant at the Site is approximately nine acres on Mills Gap Road in Asheville, Buncombe County, North Carolina. The approximate center of the Site is located at north latitude 35°29'36" and west longitude 82°30'25". The Site formerly contained an approximate 95,000-square foot, single-story brick and metal structure in the southern portion of the Site. The building was demolished in December 2011 and the concrete building pad remains intact. The northeastern portion of the Site contains an asphalt-paved parking area and asphalt-paved driveways are located parallel to the north (front) of the building and southeast (rear) of the building. A six-foot high chain-link fence surrounds the Site and a locked gate at the north end of the Site controls access to the Site from Mills Gap Road. The Site is unoccupied.

1.2 SITE OPERATIONAL HISTORY

International Resistance Company owned and operated a manufacturing facility at the Site from 1952 until 1959, when CTS of Asheville, Inc. purchased the real property, building, and equipment. CTS of Asheville, Inc. manufactured electronic components at the facility from 1959 until April 1986. Arden Electroplating, Inc. leased a portion of the building from approximately December 1, 1985 until November 30, 1986, and the Site was conveyed to Mills Gap Road Associates (MGRA) on December 23, 1987. MGRA reportedly leased portions of the facility to various tenants, and otherwise utilized the



building for business interests. The Site has been vacant/unoccupied since the mid-1990s, and the building was demolished in December 2011.

Electronic components utilized in automotive parts and hearing aids were manufactured at the Site until plant operations ceased in April 1986. Small electronic components were electroplated with tin, nickel, zinc, and silver as one step in the manufacturing process. Wastes generated from the process included sludge containing heavy metals and solvents. Solvents, including trichloroethene (TCE) and acetone were used in the process to clean and/or degrease metal objects prior to electroplating and the spent solvents were disposed of accordingly. Disposal/recycling activities at the facility prior to 1959 are unknown. From 1959 to 1986, solvents and metals were reportedly reclaimed whenever possible. Between 1959 and 1980, metal-bearing rinse waters and alkaline cleaners that could not be reclaimed from the electroplating process were reportedly disposed of through the city sewer system, while concentrated metals and solvent wastes were placed in drums for off-site disposal/recycling. After 1980, all wastes were accumulated in drums on-site prior to off-site disposal or recycling.

1.3 PREVIOUS WATER SUPPLY MONITORING ACTIVITIES

Water supply monitoring was conducted within an approximate one-mile radius of the Site by the USEPA on a quarterly schedule between December 2007 and March 2012. Data related to the water supply monitoring activities is maintained by USEPA in a database. According to information provided by USEPA, approximately 110 water supply locations were sampled during each recent quarterly sampling event, and the collected water samples were generally analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals (selected wells), and cyanide. In accordance with Section 3.1.6 of the Settlement Agreement Scope of Work, additional monitoring events will be performed by the Respondent in accordance with the Interim Response Measure Work Plan to Supplement the Removal Action Plan of February 4, 2005.

1.4 OBJECTIVES OF THE WORK PLAN

The objective of this Work Plan is to describe the proposed water supply monitoring program associated with the Site, and includes:



- Identification of properties within a one-mile radius of the former plant at the Site that obtain potable water from a water supply well or spring
- A strategy for obtaining access agreements for sampling identified water supply wells and springs
- Procedures for collection and analysis of water supply samples, including documentation and quality assurance/quality control procedures
- Data evaluation, notification, and reporting procedures

2.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

The area surrounding the Site is considered rural and contains residential and light commercial properties. The Site is situated on a topographic “saddle” between two prominent mountains, Busbee Mountain to the north and Brown Mountain to the south and southwest. Properties northwest and southeast are topographically downgradient of the Site. The majority of the Site is relatively flat and natural surface drainage at the Site is to the northwest. The surrounding area contains mountains and rolling hills, typical of the eastern flank of the Appalachian Mountain range.

The Site is located in the Blue Ridge Physiographic Province, which is characterized by mountainous terrain, relatively high precipitation and a dense network of perennial streams. The Site is underlain by metasedimentary and metavolcanic rocks of the Ashe Metamorphic Suite (NCGS, 2008). Metasedimentary rocks in the Ashe Metamorphic Suite are metamorphosed clastic sediments, such as deepwater sandstone and shale, and are generally described in the area of the Site as schistose metagraywacke, mica schist, and metagraywacke. Amphibolite, formed by the metamorphism of subaqueous volcanic intrusions, is present in isolated deposits in the metasedimentary assemblages.

The bedrock is generally overlain by a mantle of unconsolidated residual soil (overburden) formed by the in-place weathering of bedrock. The typical residual soil profile in areas not disturbed by erosion or human activities consists of silty or clayey soils near the surface where weathering is more advanced, underlain by sandy silt and silty sand. Less weathered rock, commonly termed “partially weathered rock” (PWR), forms a “rind” on the bedrock that ranges in thickness from several feet to tens of feet. The contact between partially weathered rock and competent bedrock is irregular, even over short horizontal distances. Alluvial and floodplain deposits (water deposited) are typically found overlying residual soil in areas near streams and drainage features. Soils transported downslope by gravity (mudflows or landslides), termed colluvium, are often found on or near the toe of natural slopes.

Groundwater flow in the Blue Ridge region is typically divided into two, connected but characteristically different, flow regimes - flow through the porous overburden, and flow through discrete fractures in bedrock. The overburden typically acts as an infiltration medium for precipitation, and if sufficiently thick/deep, becomes saturated at some depth



and a saturated zone is present above bedrock. Groundwater flows laterally through the overburden toward a discharge zone (surface water feature) or downward into fractures in the underlying bedrock. The rate and direction of groundwater flow in the overburden is controlled primarily by topographic features, the porosity of the overburden, and structural features that create preferential flow paths (e.g., quartz veins, sandy lenses, etc.). The majority of groundwater occurrence and flow in crystalline bedrock is through a network of fractures, which are formed by tectonic and deformational forces (e.g. metamorphism and intrusions).

The majority of water supply wells in the Blue Ridge Physiographic Province obtain groundwater from the crystalline bedrock. The depth of water supply wells is dependent upon the depth at which water-bearing fractures are encountered, and in consideration of the yield of the fracture(s) and the population served by the well. Springs are also used for water supply sources, if sufficient quantity and quality of groundwater discharges from the spring. Spring water is typically routed into a cistern via gravity and then pumped to a water distribution system. In the Blue Ridge, springs typically discharge where the water table intersects ground surface from either the overburden or bedrock.



3.0 WATER SUPPLY MONITORING PROGRAM

In accordance with Section 3.1.6 of the Settlement Agreement Scope of Work, the Respondent, will perform quarterly water supply monitoring within an approximate one-mile radius of the former plant at the Site.

The Sampling and Analysis Plan for implementation this Work Plan consists of a Field Sampling and Analysis Plan (FSAP) and Quality Assurance Project Plan (QAPP). The FSAP (Appendix A) describes the data gathering methods, sampling objectives, sample locations and frequency, sampling equipment and procedures, decontamination procedures and management of investigative derived waste. The QAPP (Appendix B) describes the project objectives and organization, functional activities, and the quality assurance and quality control (QA/QC) protocols that will be used to achieve the desired data quality objective for the project. The water supply monitoring program is described below.

3.1 IDENTIFICATION OF WATER SUPPLY WELLS AND SPRINGS

In May 2012, the USEPA notified owners of water supply wells and springs within an approximate one-mile radius of the former plant at the Site that future sampling will be conducted by CTS' contractor. In this notification, USEPA included a new access agreement form. Where access for sampling is granted by the well/spring owner, USEPA has transmitted the information to CTS' contractor for inclusion of these properties in the proposed water supply monitoring program. If access to additional properties is received by USEPA after implementation of this Work Plan, USEPA will transmit the information to CTS' contractor for inclusion of these properties in the proposed water supply monitoring program

The sampling area may be expanded or contracted, as agreed to by USEPA, depending upon the results of the water quality monitoring, implementation of an Interim Response Measure, data produced during the Remedial Investigation, and such other data or information as relevant to determine the necessity and efficacy of the water supply sampling and analysis.

3.2 ACCESS AGREEMENT STRATEGY

The collection and analysis of drinking water samples will be available to eligible property owners. Eligible property owners are those that meet the following: 1) property owner, or tenant, obtains their drinking water from a water supply well or spring on their property and 2) the water supply well or spring is within a one-mile radius of the former plant at the Site. Access agreements will be obtained from eligible property owners prior to initiating quarterly well monitoring. Where a water supply well or spring is shared with more than one residence, the access agreement will be acquired from the owner of the property in which the water supply well or spring is located.

An access agreement request will be sent by USEPA to eligible property owners as part of an Interim Response Measure offering whole-house water filtration systems. The access agreement request will contain a form granting permission (or not granting permission) to access the water supply source for the purpose of collecting a water samples for analysis by a certified laboratory. This form will include a place for the property owner to sign, provide updated contact information (if applicable), and tenant information (if applicable).

If a response is not received within the timeframe indicated in the access agreement request letter, the water supply well or spring sampling will not be included in the next monitoring event. If a response is received after the timeframe included in the letter, the water supply well or spring will be included in the subsequent quarterly monitoring event.

3.3 PROPERTY OWNER NOTIFICATION

Prior to commencing a quarterly water monitoring event, property owners will be notified by USEPA of the upcoming sampling activities. USEPA will coordinate the timing and logistical issues associated with the sampling activities. USEPA will communicate to the Respondent, or the Respondent's representative, which property owners have granted access for collecting a water supply well/spring sample, and will provide results of the above property owner requests.

3.4 COLLECTION OF WATER SUPPLY SAMPLES

Water supply samples will be collected in accordance with the procedures described in the FSAP and QAPP. A quarterly water quality monitoring event will generally include the following activities:

- Property owner notification by USEPA
- Receipt and documentation of sampling containers
- Calibration of water quality measurement equipment
- Mobilization to sampling locations
- Accessing sampling locations (e.g., spigot at wellhead, spigot closest to wellhead, etc.), including identifying appropriate purge water discharge location
- Well purging and water quality measurement during purging
- Collection of field and QA/QC samples, including proper chain-of-custody documentation
- Preservation and packaging of samples
- Transport to laboratory either by commercial overnight transporters or via a laboratory courier
- Documentation of sampling activities

3.5 ANALYSIS OF WATER SUPPLY SAMPLES

Based on previous investigations of groundwater at the Site, and previous water supply well sampling events, chlorinated VOCs, primarily TCE, are the target monitoring compounds and include the following:

- 1,1-Dichloroethene
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Tetrachloroethene
- 1,1,1-Trichloroethane
- Trichloroethene
- Vinyl chloride

In order to detect the above target monitoring compounds, the water supply samples will be submitted for analysis according to USEPA Method 8260B. QA/QC documentation and procedures are described in the QAPP.



The constituents analyzed may be modified, as agreed to by USEPA, depending upon the results of the water quality monitoring, implementation of an Interim Response Measure, data produced during the Remedial Investigation, and such other data or information as relevant to determine the necessity and efficacy of the water supply sampling and analysis.

3.6 HEALTH AND SAFETY

A Site Health and Safety Plan (HASP) has been developed specific to the Site activities and has been submitted to the USEPA under separate cover. The HASP applies to AMEC employees and AMEC subcontractors, only. Field teams will have a copy of the HASP during field activities. Personnel involved in the water supply monitoring activities will be required to read, understand, and conform to the requirements of the HASP.

If the Field Operations Leader or Project Manager determines that sampling activities cannot be conducted due to the proximity of unauthorized persons or other unforeseen conditions or situations, the sampling activities will cease until such time as they can safely be resumed. USEPA will be notified of such occurrences.

3.7 REPORTING

The reporting procedures described herein have been developed in accordance with Sections 3.1.6, 3.4.2, and 3.4.3 of the Settlement Agreement Scope of Work.

Laboratory analytical results will be scheduled to be received by AMEC within 21 days of sample submittal to the laboratory. The analytical results will be reviewed upon receipt from the laboratory to determine if any constituents were detected at concentrations that exceed the USEPA Maximum Contaminant Level (MCL). If exceedances are identified, the USEPA will be contacted within 24 hours of receipt of the laboratory results. A summary table of the analytical results and associated MCL concentrations will be submitted to USEPA within three days of receipt of the analytical results. Draft transmittal letters to property owners will be submitted to USEPA within 14 days of receipt of the analytical results and a Water Supply Monitoring Report will be submitted to USEPA within 30 days of receipt of the analytical results. The draft transmittal letters will be



prepared in accordance with "Communicating Environmental Data to Property Owners and Tenants" (USEPA, 2010).

3.8 MODIFICATIONS TO WATER SUPPLY MONITORING WORK PLAN

In accordance with Section 3.1.6 of the Settlement Agreement Scope of Work, the frequency, location of, and constituents to be sampled will be reviewed on a quarterly basis by USEPA and the Respondent. If modifications are made to the water supply monitoring requirements and/or procedures described in this Work Plan, including the associated FSAP and/or QAPP, a revised Work Plan or addendum will be distributed to the appropriate parties.



4.0 SCHEDULE

The schedule presented below includes tasks associated with the water supply monitoring activities, including collection of samples, laboratory analysis, notification (if necessary) and reporting. The schedule assumes that access agreements are obtained prior to initiating the quarterly water supply monitoring activities, and does not include tasks associated with providing bottled water or an Interim Response Measure, if determined necessary. The first water supply monitoring event to be conducted by the Respondent may occur in September 2012, and the sampling protocol will be dependent upon homeowner access responses received during implementation of the Interim Response Measure Work Plan to Supplement the Removal Action Plan of February 4, 2005.

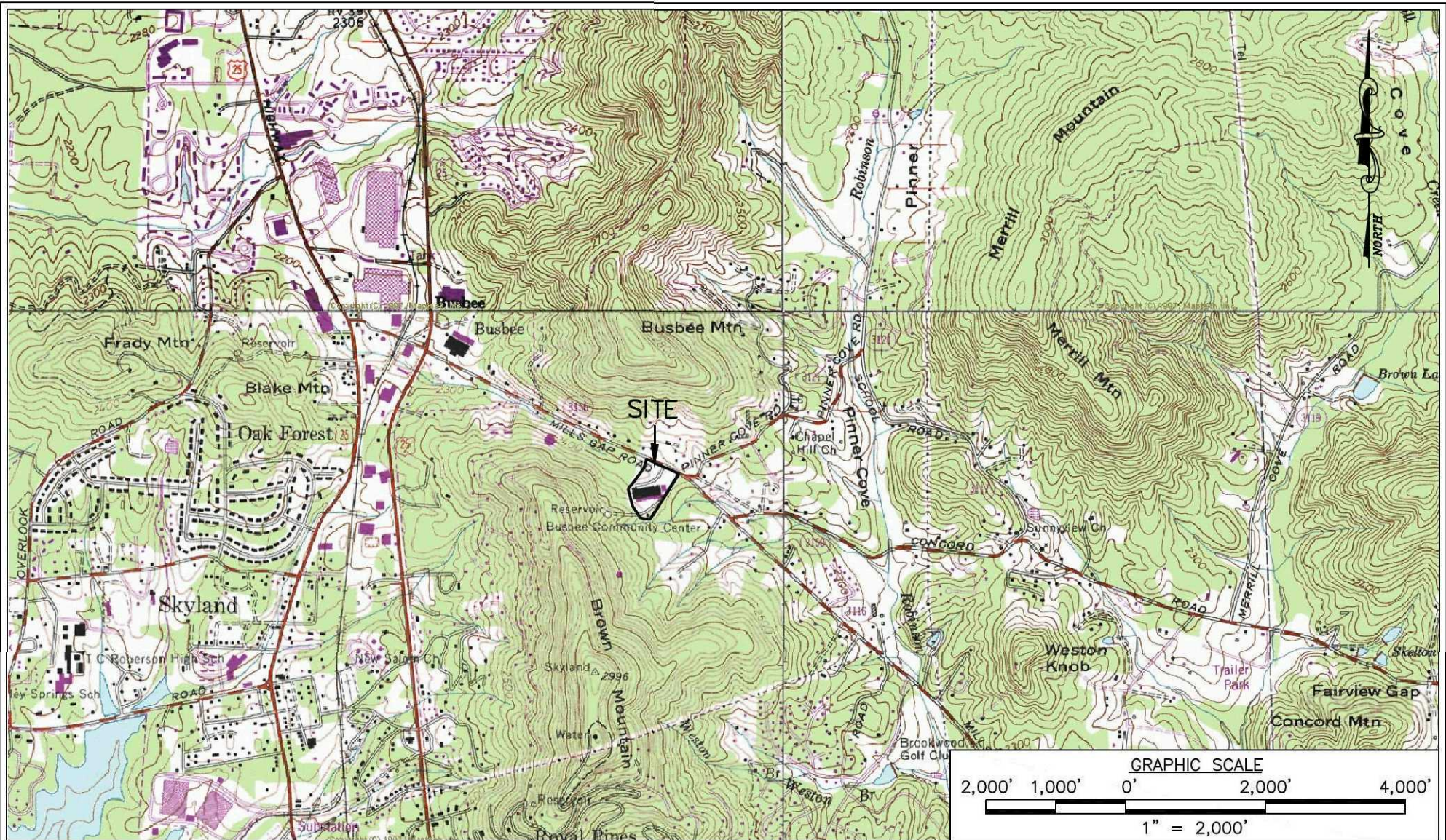
Activity	Time to Complete
USEPA to contact property owners to notify of upcoming sampling	5 days (includes time to contact property owners and receive responses)
Collect water supply samples and submit to laboratory for analysis	approximately one week
Laboratory analysis	21 days
Receive laboratory results package and conduct preliminary review to identify samples with constituent detection(s) above the applicable limits.	1 day
If samples are identified with constituent detections(s) above the applicable limits, notify USEPA and submit the associated analytical results to USEPA.	1 day (within 24 hours of receipt of analytical results)
Submit a copy of the analytical results and a summary table with applicable regulatory levels USEPA	3 days of receipt of analytical results
Submit draft "transmittal" letters to USEPA for USEPA's signature and distribution to property owners and tenants	14 days of receipt of analytical results
Submit a Water Supply Monitoring Report to USEPA	30 days of receipt of analytical results

5.0 REFERENCES

North Carolina Geological Survey, 2008. Bedrock Geologic Map of the Oteen 7.5-Minute Quadrangle, North Carolina.

USEPA, 2010. Communicating Environmental Data to Property Owners and Tenants (Standard Operating Procedure, Version #1), Interim Final, October 2010.

FIGURE



TOPOGRAPHIC SITE LOCATION MAP
 CTS OF ASHEVILLE, INC. SUPERFUND SITE
 ASHEVILLE, NORTH CAROLINA



DRAWN: SEK

ENG CHECK: --

DATE: AUGUST 2012

PROJECT: 6252-12-0006

DFT CHECK: MEW

APPROVAL: MEW

SCALE: 1" = 2,000'

FIGURE: 1

REFERENCE: USGS QUADRANGLES: ASHEVILLE (1961), OTEEN (1962), FRUITLAND (1978) AND SKYLAND (1978)



APPENDIX A

FIELD SAMPLING AND ANALYSIS PLAN

WORK PLAN FOR MONITORING OF DRINKING WATER WELLS: FIELD SAMPLING AND ANALYSIS PLAN (REVISION 1)

CTS OF ASHEVILLE, INC. SUPERFUND SITE

**235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762**

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APPENDIX

- A SESD Operating Procedures



LIST OF ACRONYMS

AMEC	AMEC Environment & Infrastructure, Inc.
bgs	below ground surface
FSAP	Field Sampling and Analysis Plan
FOL	Field Operations Leader
GPS	Global Positioning System
IDW	investigation derived waste
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
USEPA	United States Environmental Protection Agency

DOCUMENT REVISION LOG

Revision	Date	Description
0	2/24/2012	Initial Issuance
1	8/30/2012	Revisions based on comments received from USEPA in a letter dated April 25, 2012 ("Comments on the Work Plan for Monitoring of Drinking Water Wells").



1.0 INTRODUCTION

On behalf of CTS Corporation (CTS), AMEC Environment & Infrastructure, Inc. (AMEC) has prepared this Field Sampling and Analysis Plan (FSAP) for the CTS of Asheville, Inc. Superfund Site (Site) located in Asheville, Buncombe County, North Carolina. The activities described in this FSAP will be performed pursuant to the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (Settlement Agreement) between the United States Environmental Protection Agency (USEPA) Region 4 and CTS Corporation, effective January 26, 2012.

This FSAP presents the procedures and methods associated with the Work Plan for Monitoring of Drinking Water Wells (Work Plan). This FSAP, in conjunction with the Quality Assurance Project Plan (QAPP), are included in the Work Plan and provide the framework upon which the investigation will be conducted.

2.0 SAMPLING OBJECTIVE

Soil and groundwater contamination has been identified at the CTS of Asheville, Inc. Superfund Site. Some residents within a mile of the former plant at the Site obtain potable water from water supply wells and springs. The objective of the water supply monitoring is to collect water supply samples to monitor potential target chlorinated volatile organic compound (VOC) contamination within an approximate one-mile radius of the former plant at the Site.

3.0 WATER SUPPLY MONITORING PROGRAM

Water supply sampling locations will be within an approximate one-mile radius of the former plant at the Site. Water supply wells and springs will be identified using data collected by the USEPA during water supply sampling events conducted between December 2007 and March 2012. Access agreements will be obtained from water supply well/spring owners prior to commencing the monitoring program.

Water supply monitoring events will be conducted on a quarterly basis. Well/spring owners will be notified of the sampling activities by USEPA prior to beginning the sampling event. Water supply well samples will be collected from the wellhead or the spigot nearest

the wellhead. Water supply spring samples will be collected directly from the spring. The water supply samples will be submitted for analysis of target chlorinated VOCs as described in the Work Plan for Monitoring of Drinking Water Wells QAPP. The sampling activities are expected to take up approximately one week to complete. Quality assurance/quality control samples will be collected/submitted as described in the QAPP.

Sample collection activities will be documented in field logbooks and on field data record forms (FDRs). Use of logbooks is described in the QAPP. Examples of FDRs that are anticipated to be used during well supply monitoring program are contained in Appendix C of the QAPP.

The samples will be submitted for analysis with a maximum turnaround time of 21 days from the laboratory's receipt of the samples. The analytical results will be reviewed upon receipt from the laboratory to determine if any constituents were detected at concentrations that exceed the applicable regulatory levels. If exceedances are identified, the USEPA will be contacted within 24 hours of receipt of the laboratory results. A summary table of the analytical results and associated regulatory levels will be submitted to USEPA within three days of receipt of the analytical results. Draft transmittal letters will be submitted to USEPA within 14 days of receipt of the analytical results and a Water Supply Monitoring Report will be submitted to USEPA within 30 days of receipt of the analytical results.

4.0 SAMPLE DESIGNATION, HANDLING, AND ANALYSIS

Procedures for sample designation, handling, and analysis are included in the Work Plan for Monitoring of Drinking Water Wells QAPP.

5.0 SAMPLING EQUIPMENT AND PROCEDURES

The following data collection or sampling methods are proposed for the water supply monitoring program:

- Measurement of water quality parameters
- Collection of water supply samples from well sources.
- Collection of water supply samples from spring sources.
- Surveying sample locations.

5.1 MEASUREMENT OF WATER QUALITY PARAMETERS

Water quality parameters will be collected during purging water supply wells and after collection of spring samples. The following water quality parameters will be measured:

- pH
- Temperature
- Conductivity
- Turbidity

The water quality measurement equipment includes a turbidity meter and a water quality meter that measures pH, conductivity, and temperature. The equipment will be calibrated each day prior to sample collection in accordance with the manufacturer's specifications. Calibration data will be recorded on a Field Instrument Calibration Record FDR found in Appendix C of the Water Supply Monitoring QAPP. If drifting or erroneous readings occur during operation, the equipment will be checked for calibration, and re-calibrated if necessary. If the equipment cannot be re-calibrated, the Field Operations Leader (FOL) will be notified, and operable equipment will be identified/procured for use.

Water quality parameters will be measured in accordance with the most recent version of the following USEPA Science and Ecosystem Support Division's (SESD's) Operating Procedures found in Appendix A:

- "Field pH Measurement," effective June 13, 2008
- "Field Specific Conductance," effective January 13, 2012
- "Field Temperature Measurement," effective February 4, 2011
- "Field Turbidity Measurement," effective June 13, 2008

5.2 COLLECTION OF WATER SUPPLY WELL SAMPLES

Water supply well samples will be collected in accordance with SESD's Operating Procedure "Potable Water Supply Sampling," effective date November 1, 2007. A sample will be collected from a spigot at the wellhead, or at the nearest tap/spigot to the wellhead. If a water supply system has a Respondent-installed Interim Response Measure filtration system, a water sample will be collected pre-filter (at the wellhead or at a sample port 'upstream' of the filtration system) and post-filter (at an interior faucet or at a sample port 'downstream' of the filtration system). If a water sample is to be collected from a faucet that has a faucet filter, the filter will be bypassed (i.e., turned off) or removed prior to purging and collecting the water sample, and the filter will be turned on or replaced after the sample has been collected.

If a sample can be collected from an exterior spigot, a garden hose will be connected to the spigot for purging purposes. The garden hose discharge will be located in an area where the discharged purge water will not cause excessive disturbance to the property or the property owner (i.e., wetting the driveway when temperatures are below freezing, causing water to collect/pool adjacent to structures with a basement, eroding landscaping/soil, etc.). If a sample is collected from an interior tap/faucet, purging will be accomplished by turning on the cold water and allowing the purge water to discharge through the plumbing system.

The well system will be purged for at least 15 minutes. If a well has a poor recharge rate, the purge time will be reduced. Water quality parameters will be measured and recorded on the Water Supply Well Sampling Record FDR found in Appendix C of the QAPP. Parameters will be measured initially, and at approximate three-minute intervals during purging, using a calibrated water quality meter and turbidity meter. The recorded water quality measurements will be evaluated for stabilization and turbidity. Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Units (SU), the conductivity varies no more than 10 percent, and the temperature remains constant ($\pm 2^{\circ}\text{C}$). The turbidity level should be below 10 Nephelometric Turbidity Units (NTUs) prior to collecting a sample. If after 15 minutes, the water quality parameters have not stabilized and/or the turbidity is above 10 NTUs, the well can continue to be purged until parameters stabilize and turbidity is reduced to be 10 NTUs; however, additional purging is ultimately at the discretion of the FOL and/or the

Project Manager. If a well has a poor recharge rate and the purging time is reduced, there will be fewer parameter readings, and the parameters might not stabilize prior to sample collection. Modifications to the purging procedure will be documented in the field log book.

Water quality samples will be collected following purging. The samples will be collected directly from the spigot/faucet where purging was conducted. The discharge flow will be reduced to a low flow to minimize sample disturbance. Samples will be collected directly into the sample containers, if possible. If a spigot has a low clearance, and the sample bottle cannot directly access the water flow, a clean, laboratory supplied jar/bottle or decontaminated stainless steel scoop can be used to collect the sample and then decant the sample into the appropriate sample containers. Samples will immediately be placed on ice following collection and will be packaged and shipped with appropriate chain-of-custody as described in the Water Supply Monitoring QAPP.

Clean, non-powdered, disposable gloves (e.g. nitrile) will be worn when collecting the water supply well samples. A new pair of gloves will be donned immediately prior to sampling (i.e., after purging and before collecting a sample). Information regarding the collected sample (e.g., sample designation, analyses, etc.) will be recorded on the Water Supply Well Sampling Record FDR.

5.3 COLLECTION OF WATER SUPPLY SPRING SAMPLES

Water supply spring samples will be collected in accordance with SESD's Operating Procedure "Surface Water Sampling," effective date November 1, 2007. Water supply spring samples will be collected at the spring source, if possible.

Spring samples will be collected by dipping the sample containers directly in the water, if the water is deep enough to allow for tipping the container without losing the preservative in the sample container. If sample collection via dipping is not possible, a decontaminated stainless steel scoop will be used to collect the sample and transfer the sample to the appropriate containers. Care will be taken not to disturb sediment/soil around/in the spring to minimize sample turbidity. Samples will immediately be placed on ice following collection and will be packaged and shipped with appropriate chain-of-custody as described in the Water Supply Monitoring QAPP.

Water quality parameters (pH, conductivity, temperature, and turbidity) will be measured and recorded on the Water Supply Spring Sampling Record FDR after the spring samples have been collected. The field sampler will also record observations about the appearance of the surface water samples and a description of the sample location (e.g., water depth, substrate, flow, color, staining, flocculate) that is observed on the FDR.

Clean, non-powdered, disposable gloves (e.g. nitrile) will be worn when collecting the spring samples. A new pair of gloves will be donned immediately prior to sampling. Information regarding the collected sample (e.g., sample designation, analyses, etc.) will be recorded on the Water Supply Spring Sampling Record FDR.

5.4 SURVEYING

The coordinates of previously sampled water supply wells/springs will be provided by USEPA. If new water supply locations are added to the monitoring program, the new location will be surveyed, as described below. If an existing location is modified (i.e., the sample has to be collected from a different spigot on the property), the modified location will be noted in the field log book.

New sampling locations will be surveyed using a Trimble® Global Positioning System (GPS) or similar instrument. As specified in SESD Operating Procedure "Global Positioning System," effective date April 20, 2011, sample locations will be located with three meter accuracy. If a location is in an area where a GPS signal cannot be received (e.g. areas with tree canopy), the GPS locations will be located from the nearest point where a signal is received and deviations will be noted in the field book.

6.0 DECONTAMINATION PROCEDURES

It is anticipated that the majority of samples will be collected directly from a tap/spigot at the wellhead and that equipment decontamination will not be necessary. However, the use of a sample collection scoop or bowl may be needed at some locations and decontamination of the collection device may be necessary. The objective of this section is to provide procedures for removal of contaminants from sampling field equipment to concentrations that do not adversely impact the investigation objectives. The decontamination procedures have been developed in accordance with SESD's Operating

Procedure "Field Equipment Cleaning and Decontamination," effective December 20, 2011. Deviations from these procedures will be communicated to the field operations leader (FOL) and documented in the field log book.

6.1 CLEANING SOLUTIONS

Specifications for standard cleaning materials referred to in this section are as follows:

- Potable water shall be obtained from a drinking water tap and containerized in a clean plastic bucket or plastic spray/squeeze bottle. The container shall be labeled as "potable water."
- Distilled water can be used in place of potable water, if necessary.
- Soap shall be a standard brand of phosphate-free laboratory detergent such as Alconox[®] or Liquinox[®]. Soap shall be kept in a plastic or glass container until use, and dispensed directly from the container. The soap container will be labeled with its contents.
- Organic-free water will be stored in glass or plastic containers that can be closed between uses. The organic-free water container will be labeled as such.

6.2 SAMPLING EQUIPMENT DECONTAMINATION

The following procedures will be used to decontaminate non-dedicated, non-disposable field sampling equipment (e.g., spoons, bowls):

- Equipment will be cleaned prior to sampling and between sampling locations.
- Equipment will be washed with potable water and soap, rinsed with potable water, and then rinsed with organic-free water.

6.3 SAFETY PROCEDURES FOR FIELD CLEANING OPERATIONS

Field personnel will exercise caution and follow applicable safety procedures contained in the HASP when handling cleaning materials. At a minimum, the following precautions will be taken in the field during these cleaning operations:

- Safety glasses and nitrile gloves will be worn during decontamination of sampling equipment.
Eating, smoking, drinking, or any hand to mouth contact will not be permitted during the cleaning operations.

6.4 HANDLING OF CLEANED EQUIPMENT

After field cleaning, personnel wearing clean gloves will handle equipment to prevent re-contamination. If the equipment is not to be immediately re-used it will be covered/wrapped with aluminum foil and stored in an area away from potential contaminants.

7.0 MANAGEMENT OF INVESTIGATION DERIVED WASTE

The procedures associated with the management of investigative derived waste (IDW) have been developed in accordance with the SESD Operating Procedure "Management of Investigation Derived Waste," effective October 15, 2010. IDW that will potentially be generated during implementation of the water supply monitoring program include:

- Purge water from exterior taps/spigots
- Decontamination fluids;
- Personal protective equipment;
- Disposable items (e.g., aluminum foil)

The IDW to be generated during implementation of the water supply monitoring program are expected to be relatively free of contamination. Liquid IDW will be discharged to the ground surface in such a manner as to not cause excessive disturbance to the property or the property owner where the purging or decontamination occurs. Solid IDW will be placed in trash bags and disposed of in a municipal solid waste dumpster.

8.0 REFERENCES

- USEPA, 2007. Potable Water Supply Sampling, Science and Ecosystem Support Division, Athens, GA; SESDPROC-305-R1, November 1, 2007.
- USEPA, 2007. Surface Water Sampling, Science and Ecosystem Support Division, Athens, GA; SESDPROC-201-R1, November 1, 2007.
- USEPA, 2008. Field pH Measurement, Science and Ecosystem Support Division, Athens, GA; SESDPROC-100-R2, June 13, 2008.
- USEPA, 2008. Field Turbidity Measurement, Science and Ecosystem Support Division, Athens, GA; SESDPROC-103-R2, June 13, 2008.
- USEPA, 2010. Management of Investigation Derived Waste, Science and Ecosystem Support Division, Athens, GA; SESDPROC-202-R2, October 15, 2010.
- USEPA, 2011. Field Temperature Measurement, Science and Ecosystem Support Division, Athens, GA; SESDPROC-102-R3, February 4, 2011.
- USEPA, 2011. Global Positioning System, Science and Ecosystem Support Division, Athens, GA; SESDPROC-110-R3, April 20, 2011.
- USEPA, 2011. Field Equipment Cleaning and Decontamination, Science and Ecosystem Support Division, Athens, GA; SESDPROC-205-R2, December 20, 2011.
- USEPA, 2012. Field Specific Conductance Measurement, Science and Ecosystem Support Division, Athens, GA; SESDPROC-101-R4, January 13, 2012.



APPENDIX A

SESD OPERATING PROCEDURES

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Field pH Measurement**

Effective Date: June 13, 2008

Number: SESDPROC-100-R2

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Date: 6-2-08

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
<p>SESDPROC-100-R2, <i>Field pH Measurement</i>, Replaces SESDPROC-100-R1</p> <p>Cover Page: Author was changed from Marty Allen to Ron Phelps.</p> <p>Revision History Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 1.3 Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 2 Added requirements for unattended deployment of in-situ monitoring equipment.</p> <p>Section 3.1 and 3.2, 4 Clarified requirements for routine and NPDES compliance monitoring.</p> <p>Section 3.2, 2 and 5 Added first sentence for clarification.</p>	<p>June 13, 2008</p>
<p>SESDPROC-100-R1, <i>Field pH Measurement</i>, replaces SESDPROC-100-R0</p> <p>General Deleted all references to SOSA.</p> <p>Updated referenced procedures due to changes in title names and/or to reflect most recent version.</p> <p>Replaced “shall” with “will”.</p> <p>Title Page Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove’s title from Acting Chief to Chief.</p>	<p>November 1, 2007</p>

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<p>Section 1.3 Updated information to reflect that procedure is located on the H: drive of the LAN.</p> <p>Section 1.4 Alphabetized and revised the referencing style for consistency.</p> <p>Section 2 Added last paragraph regarding stopping measurements due to environmental conditions.</p> <p>Section 3.4 Re-phrased procedure #2 for clarity.</p>	
SESDPROC-100-R0, Field pH Measurement, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes procedures, methods and considerations to be used and observed when conducting field pH measurements in aqueous phase environmental media, including groundwater, surface water and certain wastewaters.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when measuring the pH of aqueous phase environmental media in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section cannot be used to obtain pH measurements of the media being sampled, and that another method must be used to obtain said measurements, the variant instrument and/or measurement procedure will be documented in the field log book and subsequent investigation report, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when conducting field pH measurements. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

All field pH measurements pertinent to the sampling event should be recorded in the field log book for the event. All records, including a unique, traceable identifier for the instrument, such as a property number or serial number, should be entered according to the procedures outlined in the SESD Operating Procedure for Logbooks (SESDPROC-010) and the SESD Operating Procedure for Equipment Inventory and Management, (SESDPROC-108).

Care should be taken not to contaminate standards and samples and verify the expiration date of all standards prior to use. All meters should be calibrated, operated and maintained according to the manufacturer's specifications.

2 Quality Control

All pH meters will be maintained and operated in accordance with the manufacturer's instructions and the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). Before a meter is taken to the field, it will be properly calibrated and verified, according to Section 3.2 of this procedure, to ensure it is operating properly. These calibration and verification checks will be documented and maintained in a logbook.

The ambient temperature in the immediate vicinity of the meter should be measured and recorded in the field logbook to insure the instrument is operated within the manufacturer's specified range of operating temperatures. For instruments that are deployed for in-situ measurements, the temperature of the medium being monitored should be measured and recorded in the logbook prior to deployment. *In-situ monitoring equipment may be utilized in unattended deployments where autonomous logging may preclude temperature measurement prior to deployment. Because in situ instrumentation generally has a wide range of operating temperature, the field investigator may utilize professional judgment in determining if the operating environment is suitable for unattended deployment.*

If at any time during a field investigation, it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

3 Field pH Measurement Procedures

3.1 General

pH is defined as the negative logarithm of the effective hydrogen-ion concentration. For routine work, a pH meter accurate and reproducible to within 0.2 Standard Unit (S.U.) is suitable. For NPDES compliance monitoring, the pH meter should be accurate and reproducible to within 0.1 S.U. Both meters should have a range of 0 to 14 S.U.s and be equipped with a temperature-compensation adjustment.

3.2 Instrument Calibration

The meter will be calibrated in accordance with the manufacturer's instructions prior to use. At a minimum, a two-point calibration should be conducted to ensure the accuracy of the meter. The following calibration guidelines are minimum requirements.

1. Verify the meter's internal temperature sensor (thermistor) against a National Institute of Standards and Technology (NIST) traceable thermometer and note any differences between the thermistor and the NIST-traceable thermometer in the logbook. If the temperatures do not agree within $\pm 4^{\circ}\text{C}$, the unit or probe must be repaired or replaced. Alternatively, if the meter can be used in a manual temperature compensation mode, the NIST-traceable thermometer may be used for temperature readings and the necessary corrections applied. Check and record the temperatures of the standards and the samples.
2. If the pH range of the sample is not known, the pH of the sample to be tested should be estimated either from historical data or by using a four-color pH indicator paper or equivalent. Using this information, calibrate the pH meter with the buffers that bracket the expected pH range. Buffer solutions are commonly pH 4, 7 and 10. It may be possible to configure the pH meter so that it can be standardized with buffers other than those in the default configuration.
3. Immerse the probe in the first buffer solution and calibrate the meter to read the correct pH. After the initial buffer calibration, calibrate the meter using other buffer solutions, as appropriate. Rinse the probe with de-ionized water and blot dry or otherwise remove excess rinse water between the different buffer solutions. Record the buffer values and temperatures used to calibrate the meter.
4. Rinse the probe with de-ionized water, blot dry or otherwise remove excess rinse water and immerse it into the original buffer and read as a sample. If the meter reads within ± 0.2 S.U. of the known value of the buffer (for general applications such as ecological studies) or ± 0.1 S.U.

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(for regulatory applications such as NPDES or drinking Water programs), record the value indicated by the meter. If the meter is outside of the acceptable accuracy range, it should be recalibrated. If it is still outside of the acceptable accuracy range after the second calibration, the electrode and/or meter should be replaced.

5. Once the meter has been properly calibrated and verified (steps 1-4 above), it is ready for use. Rinse the probe with de-ionized water and store it in the manufacturer's recommended storage solution. Leave the meter on until all sample measurements are performed and the results are recorded. When collecting measurements from grab samples, it is recommended that the meter be checked periodically against the known buffer values if used for extended periods (> 4 hrs).
6. Unless the manufacturer indicates that the meter maintains its calibration after being turned off, meters must be re-calibrated if they are turned off during their period of use.

3.3 Sample Measurement Procedures

These procedures should be followed when conducting field pH measurements of grab samples:

1. Collect a sample. If the meter thermistor is to be used for the temperature of record for the measurement activity, the temperature should be read as soon as the reading stabilizes and prior to measuring the pH.

Note 1: When the pH meter response is slow, unstable, or non-reproducible, it may be necessary to check the conductivity. If the conductivity is lower than 20 to 30 $\mu\text{mhos/cm}$, it is permissible to add 1 ml of 1M potassium chloride solution per 100 ml of sample to improve response time for the probe. Recheck the pH and record.

Note 2: If the pH measurements are to be used for RCRA regulatory purposes and when the pH approaches the alkaline end ($\text{pH} \geq 11.0$) of the scale, the pH measurements should be made by a qualified analyst using laboratory quality equipment to control the sample at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

2. Immerse the probe in the sample keeping it away from the sides and bottom of the sample container. Allow ample time for the probe to equilibrate with the sample.
3. While suspending the probe away from the sides and bottom of the sample container, record the pH.

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4. Rinse the probe with de-ionized water and store it in the manufacturer's recommended storage solution until the next sample is ready.

These procedures should be followed when conducting in-situ field pH measurements:

1. Place the probe into the media to be measured and allow the pH and temperature readings to stabilize. Once the readings have stabilized, record the measurements in the logbook.
2. When deploying meters for extended periods of time, insure the measurement location is representative of average media conditions.

3.4 Operational Check

Even though it is not necessary to re-calibrate pH meters at regular intervals during the day, it is advisable to occasionally perform operational checks to determine if site conditions, such as an increase in temperature, have affected the electronics or other factors have caused the meter's performance to change or deteriorate during its period of operation. The following procedures should be followed to ensure that the performance of the meter has not changed:

1. While in use, periodically check the pH by rinsing the probe with de-ionized water, blot dry or otherwise remove excess rinse water and immerse it into the pH 7 buffer solution. If the measured pH differs by ≥ 0.2 S.U. or 0.1 S.U. (depending on the application) from the buffer solution, the meter must be re-calibrated.
2. A post-operation instrument verification check will be performed using the appropriate buffers at the end of the day or after all measurements have been taken for a particular period of operation. These measurements must be recorded in the field log book.

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

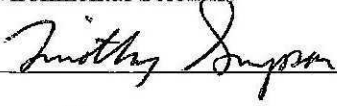
Title: **Field Specific Conductance Measurement**

Effective Date: January 13, 2012

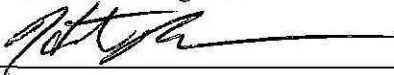
Number: SESDPROC-101-R4

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
<p>SESDPROC-101-R4, <i>Field Specific Conductance Measurement</i>, replaces SESDPROC-101-R3</p> <p>Cover Page: Hunter Johnson was added as co-author. The EIB Branch Chief was changed from Archie Lee to Danny France. The FQM was changed from Liza Montalvo to Bobby Lewis.</p> <p>Section 3.2: Replaced the first paragraph with the following language for clarification purposes: “Many brands of instruments are commercially available for the measurement of specific conductance incorporating a wide variety of technologies. The manufacturer’s instruction manual should be consulted for specific procedures regarding their calibration, maintenance and use. Calibration of any measurement instrument must be conducted and/or verified prior to each use or on a daily basis, whichever is most appropriate.”</p> <p>In the second paragraph, revised the language of the first sentence to clarify documentation procedures associated with temperatures effect on conductivity. Replaced the second sentence with “The following are basic guidelines for calibration/verification and are provided as an example:”</p> <p>The note found in Item # 3 was revised to clarify the relationship between calibration standards and the anticipated specific conductance.</p> <p>In Item # 6 the third sentence was replaced with the following: “Certain meters may require that the instrument be left on until all sample measurements are performed and the results are recorded.” In the forth sentence, replaced “it is recommended” with “certain instrument manufacturers recommend.”</p> <p>Section 3.3: In the first sentence, replaced “must” with “should.”</p>	January 13, 2012

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<p>SESDPROC-101-R3, <i>Field Specific Conductance Measurement</i>, replaces SESDPROC-101-R2</p> <p>General: Corrected any typographical, grammatical and/or editorial errors.</p> <p>Cover Page: The Author was changed from Ron Phelps to Timothy Simpson. The Enforcement and Investigations Branch Chief was changed from Antonio Quinones to Archie Lee. The FQM was changed from Laura Ackerman to Liza Montalvo.</p> <p>Section 1.2: Added the following statement: Mention of trade names or commercial products does not constitute endorsement or recommendation for use.</p> <p>Section 1.3: Omitted the reference to the H: drive of the LAN.</p> <p>Section 3.1: Added “microsiemens per centimeter ($\mu\text{S}/\text{cm}$)” in addition to micromhos per centimeter ($\mu\text{mhos}/\text{cm}$) to the first sentence.</p> <p>Section 3.2: Item #3 - Added the following statement: “Fresh standards should be used for each calibration. Item #4 - Added language related to the auto-recognition of standards during meter calibration (first 3 sentences). Added items #5 and #6.</p>	<p>August 12, 2011</p>
<p>SESDPROC-101-R2, <i>Field Specific Conductance Measurement</i>, replaces SESDPROC-101-R1</p> <p>Cover Page: Author was changed from Marty Allen to Ron Phelps.</p> <p>Revision History Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 1.3 Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 2 Added requirements for unattended deployment of in-situ monitoring equipment.</p> <p>Section 3.2 Added sentence to paragraph 2 to identify minimum requirements for calibration/verification.</p> <p>Section 3.3 Moved operational check to Section 3.4.</p>	<p>June 13, 2008</p>

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<p>SESDPROC-101-R1, <i>Field Specific Conductance Measurement</i>, replaces SESDPROC-101-R0</p> <p>General Deleted all references to SOSA.</p> <p>Updated referenced procedures due to changes in title names and/or to reflect most recent version.</p> <p>Title Page Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove's title from Acting Chief to Chief.</p> <p>Section 1.3 Updated information to reflect that procedure is located on the H: drive of the LAN.</p> <p>Section 1.4 Alphabetized and revised the referencing style for consistency.</p> <p>Section 2 Added last paragraph regarding stopping measurements due to environmental conditions.</p>	<p>November 1, 2007</p>
<p>SESDPROC-101-R0, Field Specific Conductance Measurement, Original Issue</p>	<p>February 05, 2007</p>

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1 General Information

1.1 Purpose

This document describes procedures, methods and considerations to be used and observed when conducting field specific conductance measurements in aqueous phase environmental media, including groundwater, surface water and certain wastewaters.

1.2 Scope/Application

The procedures contained in this document are to be used by field investigators when measuring the specific conductance of aqueous phase environmental media in the field. On the occasion that SESD field investigators determine that any of the procedures described in this section cannot be used to obtain specific conductance measurements of the media being sampled, and that another method must be used to obtain said measurements, the variant instrument and/or measurement procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 *Safety*

Proper safety precautions must be observed when conducting field specific conductance measurements. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 *Procedural Precautions*

All field specific conductance measurements pertinent to the sampling event, including a unique, traceable identifier for the instrument, such as a property number or serial number, should be recorded in the field logbook for the event. All records should be entered according to the procedures outlined in the SESD Operating Procedure Logbooks (SESDPROC-010).

Care should be taken to not contaminate standards and samples and verify the expiration date of all standards prior to use. All meters should be calibrated, operated and maintained according to the manufacturer's specifications.

2 Quality Control

All specific conductance meters will be maintained and operated in accordance with the manufacturer's instructions and the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). Before a meter is taken to the field, it will be properly calibrated or verified, according to Section 3.2 of this procedure, to ensure it is operating properly. These calibration and verification checks will be documented and maintained in a logbook.

The ambient temperature in the immediate vicinity of the meter should be measured and recorded in the field logbook to ensure the instrument is operated within the manufacturer's specified range of operating temperatures. For instruments that are deployed for in-situ measurements, the temperature of the medium being monitored should be measured and recorded in the logbook prior to deployment. *In-situ monitoring equipment may be utilized in unattended deployments where autonomous logging may preclude temperature measurement prior to deployment. Because in-situ instrumentation generally has a wide range of operating temperature, the field investigator may utilize professional judgment in determining if the operating environment is suitable for unattended deployment.*

If at any time during a field investigation it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

3 Field Specific Conductance Measurement Procedures

3.1 General

Specific conductance is a measure of the ability of an aqueous solution to conduct an electric current and is customarily reported in microsiemens per centimeter ($\mu\text{S}/\text{cm}$) or micromhos per centimeter ($\mu\text{mhos}/\text{cm}$) at 25°C. It is important to note that if the specific conductance measurements are for NPDES reporting purposes, the meter and conductivity cell should be verified by comparing against a laboratory meter with a platinum-electrode type conductivity cell.

3.2 Instrument Calibration and Verification

Many brands of instruments are commercially available for the measurement of specific conductance incorporating a wide variety of technologies. The manufacturer's instruction manual should be consulted for specific procedures regarding their calibration, maintenance and use. Calibration of any measurement instrument must be conducted and/or verified prior to each use or on a daily basis, whichever is most appropriate.

Conductivity is affected by temperature; therefore, for instruments that do not automatically compensate for temperature, the user should document temperature first so that appropriate adjustments can be made in accordance with the manufacturer's instructions and/or method. The following are basic guidelines for calibration/verification and are provided as an example:

1. Verify the meter's internal temperature sensor (thermistor) against a National Institute of Standards and Technology (NIST) traceable thermometer and note any differences between the thermistor and the NIST-traceable thermometer in the logbook. If the temperatures do not agree within $\pm 4^\circ\text{C}$, the unit must be repaired or replaced. Alternatively, if the meter can be used in a manual temperature compensation mode, the NIST-traceable thermometer may be used for temperature readings and the necessary corrections applied. Check and record the temperatures of the standards and the samples.
2. Rinse the probe with de-ionized water and blot dry before conducting the following calibration and verification checks.
3. Immerse the probe in the first standard solution and calibrate or verify the meter against that solution. Fresh standards should be used for each calibration. After the initial standard, calibrate and/or verify the meter using additional standards, as appropriate. Rinse the probe with de-ionized water and blot dry or otherwise remove excess rinse water between the different standards. Record the standard values/temperatures used to calibrate or verify the meter.

Note: Some instruments require that calibration standards reflect the

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anticipated specific conductance of the media being measured.

4. Some meters will auto-recognize standards during calibration. For example, the Orion Star Series meter will auto-recognize standards 1413 $\mu\text{S}/\text{cm}$, 100 $\mu\text{S}/\text{cm}$ and 12.9 mS/cm . If the meter is calibrated in a manner where it does not auto-recognize the standard, and the meter is not accurate to within $\pm 10\%$ of the standard solution(s) known values, the meter or probe should be repaired or replaced. If this condition can be corrected by adjusting the cell constant of the probe, refer to the instruction manual and make the adjustment.
5. After calibration is complete, place the probe back into the calibration standard used and record a post-calibration reading. Record a post calibration reading for each standard used. If the meter is not accurate to within $\pm 10\%$ of the standard solution(s) known values, it should be recalibrated. If it is still outside of the acceptable accuracy range after the second calibration, the probe and/or meter should be replaced.
6. Once the meter has been properly calibrated and verified (steps 1-5 above), it is ready for use. Rinse the probe with de-ionized water and store it in the manufacturer's recommended storage solution. Certain meters may require that the instrument be left on until all sample measurements are performed and the results are recorded. When collecting measurements from grab samples, certain instrument manufacturers recommend that an intermediate check(s) be performed by periodically checking the meter against the known calibration standards if used for extended periods (> 4 hrs).

3.3 Sample Measurement Procedures

The following procedures should be followed when conducting field specific conductance measurements of grab samples:

1. Collect the sample, check and record its temperature.
2. Correct the instrument's temperature adjustment to the temperature of the sample (if required).
3. Immerse the probe in the sample keeping it away from the sides and bottom of the container. It is important that the center portion of the probe be wetted by the sample.
4. Allow meter to stabilize. Record the results in a logbook.
5. Rinse probe with de-ionized water.

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The following procedures should be followed when conducting in-situ field specific conductivity measurements:

1. Place the probe into the media to be measured and allow the specific conductivity and temperature readings to stabilize. Once the readings have stabilized, record the measurements in the logbook.
2. When deploying meters for extended periods of time, ensure the measurement location is representative of average media conditions.

3.4 Operational Check

A post-operation instrument verification check should be performed using the appropriate standard(s) at the end of the day or after all measurements have been taken for a particular period of operation. These measurements must be recorded in the field logbook.

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: Field Temperature Measurement

Effective Date: February 4, 2011

Number: SESDPROC-102-R3

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Approvals

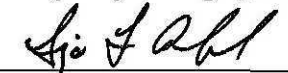
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History	Effective Date
<p>SESDPROC-102-R3, <i>Field Temperature Measurement</i>, replaces SESDPROC-102-R2</p> <p>Cover Page: Author was changed from Ron Phelps to Hunter Johnson. The Enforcement and Investigations Branch Chief was changed from Antonio Quinones to Archie Lee. The FQM was changed from Laura Ackerman to Liza Montalvo.</p> <p>Section 1.2: Added the following statement: Mention of trade names or commercial products does not constitute endorsement or recommendation for use.</p> <p>Section 1.3: Omitted the reference to the H: drive of the LAN.</p> <p>Section 1.5: In Section 1.5.1, added “The field investigators will” to the first sentence. Deleted Section 1.5.2.</p> <p>Section 2: In the first paragraph, kept the first sentence but replaced the rest of the paragraph with the following language for clarification purposes: “Temperature measurement devices such as pH, conductivity and dissolved oxygen (DO) meter thermistors will be verified against a National Institute of Standards and Technology (NIST)-traceable thermometer before each use as described in Section 3.2. Data Sonde thermistors will be verified on a monthly basis to ensure accuracy. These verification checks are documented in the instrument’s tracking logbook.”</p> <p>Deleted the second paragraph.</p> <p>Section 3.1: In the first paragraph, replaced the first sentence with: “Field temperature measurements may be made with a field thermometer, equipment thermistor, or NIST-traceable thermometer.” In the second sentence, replaced “thermometer” with “temperature measurement device.”</p> <p>Section 3.2: Created new sections 3.2.1 and 3.2.2 as follows: Converted the “Note” to new section 3.2.1. Replaced the first sentence with “Temperature measurement devices such as field thermometers and equipment thermistors will be verified against a NIST-traceable thermometer prior to use and should agree within $\pm 4.0^{\circ}\text{C}$.”</p> <p>Converted the first paragraph to section 3.2.2. Revised the original language to clarify the verification requirements of the NIST-traceable thermometers that are used to verify other temperature measuring devices, such as field thermometers and equipment thermistors.</p>	<p>February 4, 2011</p>

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<p>Section 3.3: Replaced “thermometer” with “temperature measurement device.”</p> <p>Section 3.4: Added “if not in-situ” to number 4.</p>	
<p>SESDPROC-102-R2, <i>Field Temperature Measurement</i>, Replaces SESDPROC-102-R1</p> <p>Cover Page: Author was changed from Marty Allen to Ron Phelps.</p> <p>Revision History Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 1.3 Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 2 Deleted last sentence of paragraph 1. Deleted Fisher brand stem type in paragraph 2.</p> <p>Section 3.1 Deleted “Normally” on the first sentence. Deleted the last sentence.</p> <p>Section 3.2 Changed “Calibration” to “Verification.” Added recalibration requirements.</p>	<p>June 13, 2008</p>
<p>SESDPROC-102-R1, <i>Field Temperature Measurement</i>, Replaces SESDPROC-102-R0</p> <p>General Updated referenced procedures due to changes in title names and/or to reflect most recent version.</p> <p>Title Page Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove’s title from Acting Chief to Chief.</p> <p>Section 1.3 Updated information to reflect that procedure is located on the H: drive of the LAN.</p> <p>Section 1.4 Alphabetized and revised the referencing style for consistency.</p> <p>Section 2 Added last paragraph regarding stopping measurements due to environmental conditions.</p>	<p>November 1, 2007</p>
<p>SESDPROC-102-R0, <i>Field Temperature Measurement</i>, Original Issue</p>	<p>February 05, 2007</p>

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when measuring the temperature of aqueous phase environmental media, including groundwater, surface water and certain wastewaters.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when measuring the temperature of aqueous phase environmental media in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section cannot be used to obtain temperature measurements of the media being sampled, and that another method or measurement instrument must be used to obtain said measurements, the variant instrument and measurement procedure will be documented in the field log book and subsequent investigation report, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 *Safety*

Proper safety precautions must be observed when conducting temperature measurements in the field. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. The field investigators will address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

2 Quality Control

All thermometers should be maintained and operated in accordance with the manufacturer's instructions and the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). Temperature measurement devices such as pH, conductivity and dissolved oxygen (DO) meter thermistors will be verified against a National Institute of Standards and Technology (NIST)-traceable thermometer before each use as described in Section 3.2. Data Sonde thermistors will be verified on a monthly basis to ensure accuracy. These verification checks are documented in the instrument's tracking logbook.

If at any time during a field investigation, it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

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3 Field Temperature Measurement Procedures

3.1 General

Field temperature measurements may be made with a field thermometer, equipment thermistor, or NIST-traceable thermometer. At a minimum, the temperature measurement device should be capable of measuring in 0.1°C increments.

3.2 Instrument Verification

3.2.1 Field thermometers and thermistors

Temperature measurement devices such as field thermometers and equipment thermistors will be verified against a NIST-traceable thermometer prior to use and should agree within $\pm 4.0^\circ\text{C}$. Corrections may be applied for measurements up to $\pm 4.0^\circ\text{C}$ depending on investigation objectives, but the instrument must be repaired or replaced beyond that range.

3.2.2 NIST-traceable thermometer

Verification of the NIST-traceable thermometers that are used to verify temperature measuring devices is accomplished by comparing temperature readings from the NIST-traceable thermometer to a thermometer that has an independent certification of accuracy traceable to the National Institute of Standards and Testing. Current certified thermometers are maintained by the SESD Analytical Support Branch and are called reference thermometers.

Each NIST-traceable thermometer is verified by comparing at least annually against a reference thermometer. If corrections need to be applied, they will be noted in the NIST-traceable thermometer. Depending on investigation objectives, project leaders may decide to apply the correction factor as necessary.

3.3 Inspections

All temperature measurement devices should be inspected for leaks, cracks, and/or function prior to each use.

3.4 Sample measurement procedures for thermometers/thermistors

(Make measurements in-situ when possible)

1. Clean the probe end with de-ionized water and immerse into sample.
2. If not measuring in-situ, swirl the instrument in the sample for mixing and equilibration.

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3. Allow the instrument to equilibrate with the sample for at least one minute.
4. Suspend the instrument away from the sides and bottom, if not in-situ, to observe the temperature reading.
5. Record the reading in the log book. For most applications, report temperature readings to the nearest 0.5°C or to the nearest 0.1°C depending on need.

Note: Always clean the thermometer with de-ionized water or a detergent solution, if appropriate, prior to storage and/or use.

3.5 Units

Degrees Celsius (°C) or Degrees Fahrenheit (°F)

Conversion Formulas:

$$^{\circ}\text{F} = (9/5 ^{\circ}\text{C}) + 32 \quad \text{or} \quad ^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$$

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: Field Turbidity Measurement

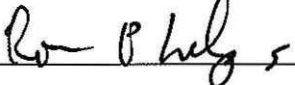
Effective Date: June 13, 2008

Number: SESDPROC-103-R2

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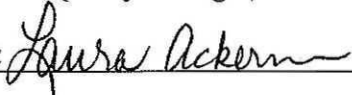
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<p>SESDPROC-103-R2, <i>Field Turbidity Measurement</i>, Replaces SESDPROC-103-R1</p> <p>Cover Page: Author was changed from Marty Allen to Ron Phelps.</p> <p>Revision History Changed Field Quality Manager to Document Control Coordinator.</p> <p>Section 1.3 Changed Field Quality Manager to Document Control Coordinator.</p>	June 13, 2008
<p>SESDPROC-103-R1, <i>Field Turbidity Measurement</i>, Replaces SESDPROC-103-R0</p> <p>General Deleted all references to SOSA.</p> <p>Updated referenced procedures due to changes in title names and/or to reflect most recent version.</p> <p>Title Page Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove's title from Acting Chief to Chief.</p> <p>Section 1.3 Updated information to reflect that procedure is located on the H: drive of the LAN.</p> <p>Section 1.4 Alphabetized and revised the referencing style for consistency.</p> <p>Section 2 Added last paragraph regarding stopping measurements due to environmental conditions.</p>	November 1, 2007

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Section 3.5 Re-phrased operational check 2 for clarity.	
SESDPROC-103-R0, Field Turbidity Measurement, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when conducting field turbidity measurements in aqueous phase environmental media, including groundwater, surface water and certain wastewaters.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when measuring turbidity of various, aqueous phase environmental media in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section cannot be used to obtain turbidity measurements of the media being sampled, and that another method or turbidity measurement instrument must be used to obtain said measurements, the variant instrument and measurement procedure will be documented in the field log book, along with a description of the circumstances requiring it's use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when conducting field turbidity measurements. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. When using this procedure, minimize exposure to potential health hazards through the use of protective clothing, eye wear and gloves. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

All field turbidity measurements pertinent to the sampling event should be recorded in the field log book for the event. All records should be entered according to the procedures outlined in the SESD Operating Procedure for Logbooks (SESDPROC-010).

2 Quality Control

All turbidity meters and probes shall be maintained and operated in accordance with the manufacturer's instructions and the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). Before a meter or probe is taken to the field, it shall be properly calibrated and verified, according to Sections 3.2 and 3.3 of this procedure, to ensure it is operating properly. These calibration and verification checks shall be documented and maintained in a logbook.

The ambient temperature in the immediate vicinity of the meter should be measured and recorded in the field logbook to insure the instrument is operated within the manufacturer's specified range of operating temperatures. For instruments that are deployed for in-situ measurements, the temperature of the medium being monitored should be measured and recorded in the logbook prior to deployment. *In-situ monitoring equipment may be utilized in unattended deployments where autonomous logging may preclude temperature measurement prior to deployment. Because in situ instrumentation generally has a wide range of operating temperature, the field investigator may utilize professional judgment in determining if the operating environment is suitable for unattended deployment.*

If at any time during a field investigation, it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

3 Field Turbidity Measurement Procedures

3.1 General

Turbidity is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter and microscopic organisms. Many methods are available for the measurement of turbidity including turbidimeters and optical probes. Turbidity is measured by determining the amount of scatter when a light is passed through a sample.

3.2 Meter Calibration and Verification

1. The turbidimeter is calibrated or verified in accordance with the manufacturer's instructions prior to use in the field. If the instrument readings do not agree within $\pm 10\%$ of the calibration standards, the unit must be recalibrated, repaired or replaced. These verifications should be documented in the field investigator's logbook.
2. Turn the meter "ON".
3. Rinse the sample cell three times with organic-free or de-ionized water.
4. Fill the cell to the fill line with organic-free or de-ionized water and then cap the cell.
5. Use a non-abrasive, lint-free paper or cloth (preferably lens paper) to wipe off excess water and streaks.
6. Open the cover and insert the cell (arrow to the front) into the unit and close the cover.
7. Press "READ" and wait for the value to be displayed.
8. Using the verification standards, repeat steps 4, 5, and 6. Record all measurements.

3.3 Probe Calibration and Verification

1. The probe is calibrated in accordance with the manufacturer's instructions prior to use in the field. If the instrument readings do not agree within $\pm 10\%$ of the calibration standards, the unit must be recalibrated, repaired or replaced. These calibrations should be documented in the field investigator's logbook.
2. Turn the meter "ON" and allow it to stabilize.

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3. Immerse the probe in the first standard solution and calibrate the probe against the solution.
4. Rinse the probe with de-ionized water, remove excess rinse water and calibrate the probe using additional standards as appropriate.
5. Record the standard values used to calibrate the meter.

3.4 Sample Measurement Procedures

These procedures should be followed when conducting turbidity measurements of grab samples:

1. Collect a representative sample and pour off enough to fill the cell to the fill line (about 15 mL) and replace the cap on the cell.
2. Wipe off excess water and any streaks with a soft, lint-free cloth (lens paper).
3. Press I/O and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
4. Insert the sample cell in the instrument so the diamond or orientation mark aligns with the raised orientation mark in the front of the cell compartment. Close the lid.
5. Select manual or automatic range selection by pressing the range key.
6. Select signal averaging mode by pressing the Signal Average key. Use signal average mode if the sample causes a noisy signal (display changes constantly).
7. Press Read. The display will show ---- NTU. Then the turbidity is displayed in NTU. Record the result after the lamp symbol turns off.
8. Rinse the cell with de-ionized water.

These procedures should be followed when conducting in-situ turbidity measurements:

1. Place the probe into the media to be measured and allow the turbidity reading to stabilize. Once the reading has stabilized, record the measurement in the logbook.
2. When deploying meters for extended periods of time, insure the measurement location is representative of average media conditions.

3.5 Operational check

1. If possible, periodically check the turbidity meter during the day by using the appropriate turbidity standards.
2. A post-operation instrument verification check should be performed using the appropriate standards at the end of the day or after all measurements have been taken for a particular period of operation. These measurements must be recorded in the field log book.

3.6 Units

Turbidity measurements are reported in nephelometric turbidity units (NTUs). It is important to note that if the turbidity measurements are for NPDES reporting purposes, all values above 40 NTU must be diluted with turbidity free water and calculated by multiplying by a dilution factor.



APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

WORK PLAN FOR MONITORING OF DRINKING WATER WELLS: QUALITY ASSURANCE PROJECT PLAN (REVISION 1)

CTS OF ASHEVILLE, INC. SUPERFUND SITE

**235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762**

Prepared for:

**CTS Corporation
905 West Boulevard North
Elkhart, Indiana 46514**

Prepared by:

**AMEC Environment & Infrastructure, Inc.
1308 Patton Avenue
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AMEC Project 6252-12-0006

August 30, 2012

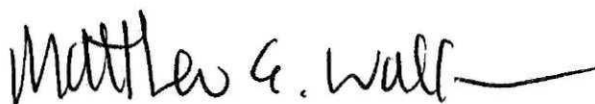


**Work Plan for Monitoring of Drinking Water Wells:
Quality Assurance and Project Plan (Revision 1)**

CTS of Asheville, Inc. Superfund Site
235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762

Prepared For: CTS Corporation
Prepared by: AMEC Environment & Infrastructure, Inc.

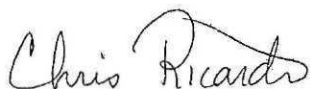
August 30, 2012



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Date



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Date

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APPENDICES

A	Organization Chart
B	Pace Analytical Services, Inc. Quality Assurance Manual
C	Example Field Data Records

LIST OF ACRONYMS

AMEC	AMEC Environment & Infrastructure, Inc.
DQO	data quality objective
EDD	electronic data deliverable
FDR	field data record
FOL	Field Operations Leader
FSAP	Field Sampling and Analysis Plan
HASP	Health and Safety Plan
IDW	investigation derived waste
LCS	laboratory control sample
LD	laboratory duplicate
MCL	Maximum Contaminant Level
MDL	method detection limit
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
OSHA	Occupational Safety and Health Act
PQL	practical quantitation limit
PM	Project Manager
QA/QC	quality assurance/quality control
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
SDG	sample delivery group
TED	Technical Environmental Database
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

DOCUMENT REVISION LOG

Revision	Date	Description
0	2/24/2012	Initial Issuance
1	8/30/2012	Revisions based on comments received from USEPA in a letter dated April 25, 2012 ("Comments on the Work Plan for Monitoring of Drinking Water Wells").

DISTRIBUTION LIST

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1.0 INTRODUCTION

On behalf of CTS Corporation (CTS), AMEC Environment & Infrastructure, Inc. (AMEC) has prepared this Quality Assurance Project Plan (QAPP) for the CTS of Asheville, Inc. Superfund Site (Site) located in Asheville, Buncombe County, North Carolina. The activities described in this QAPP will be performed pursuant to the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study between the United States Environmental Protection Agency (USEPA) Region 4 and CTS Corporation (CTS), effective January 26, 2012 (Settlement Agreement).

This QAPP has been designed to be a project document that is applicable to the monitoring of private water supply wells and springs within a one-mile radius of the former plant at the Site. This QAPP, in conjunction with the Field Sampling and Analysis Plan (FSAP), are included in the Work Plan for Monitoring of Drinking Water Wells (Work Plan) and provide the framework upon which the monitoring activities will be conducted. The QAPP has been prepared to document how the monitoring activities will be completed and includes investigation procedures, sampling methods, analytical methods, sample management, documentation procedures and Quality Assurance (QA) review procedures.

2.0 PROJECT MANAGEMENT

This section provides the overall approach to manage activities described in the Work Plan and includes the following:

- Project organization and responsibilities
- Problem definition
- Project description
- Data quality objectives
- Method performance objectives
- Special training, requirements, and certification
- Documentation and records management

2.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

The various responsibilities of key project personnel are presented in this section and a project organizational chart is presented in Appendix A.

2.1.1 AMEC Environment & Infrastructure, Inc.

AMEC will execute the water supply monitoring activities from its Asheville, North Carolina office with support from other AMEC offices. Project personnel and duties are described in the following sections.

2.1.1.1 Project Manager

The Project Manager, Mr. Matthew Wallace, PE (North Carolina), will be responsible for the scope, cost, and technical considerations related to the project; staff and project coordination; and implementation of review of overall project quality related to the collection, completeness, and presentation of data. The Project Manager oversees the technical work conducted by the Field Operations Leader, quality assurance activities by the Quality Assurance Manager, and health and safety activities by the Site Health and Safety Supervisor.

2.1.1.2 Field Operations Leader

The Field Operations Leader (FOL), Ms. Susan Kelly, LG, PE (North Carolina), will be responsible for executing the planned work elements, issuing specific instructions for

performing assigned work elements, and performing and directing the work so it is conducted in compliance with project-specific objectives and applicable QA procedures. The FOL will coordinate with the Project Manager and Quality Assurance Manager to review general work plans and specific work elements. The FOL maintains field documentation and deliverables in the project files during the performance of the assigned tasks. For field sampling activities, the FOL will be responsible for performing and/or overseeing the field work, preparing proper documentation, and ensuring proper handling of samples from sampling activities. The FOL has the authority to issue a stop work order if field sampling operations are not being conducted in accordance with the requirements specified in the Work Plan/FSAP/QAPP or when worker safety becomes an issue.

2.1.1.3 Quality Assurance Manager

The Quality Assurance Manager, Mr. Christian Ricardi, NRCC-EAC of AMEC's Portland, Maine office, will be responsible for reviewing the project QA program as it relates to the collection and completeness of data from field and laboratory operations. Mr. Ricardi's primary responsibilities include review of quality assurance/quality control (QA/QC) protocols, ascertaining quality of environmental data collected to verify that it meets proposed data quality objectives, and identifying and verifying corrective actions, if any become necessary.

2.1.1.4 Project Chemist

A Project Chemist will be responsible for reviewing laboratory reports for accuracy and completeness, performing data validation using general procedures described in the National Functional Guidelines (USEPA, 2008) modified for evaluation of USEPA SW-846 Methods. The Project Chemist will submit the validated laboratory reports with QA/QC Evaluation Sheets to the Quality Assurance Manager.

2.1.1.5 Site Health and Safety Supervisor

The Site Health and Safety Supervisor, Ms. Susan Kelly, PE, LG, is responsible for developing, implementing, and updating the Site Health and Safety Plan (HASP) to be consistent with anticipated conditions that may be encountered during field operations. Ms. Kelly will also serve as the FOL during implementation of the water supply monitoring activities.

2.1.2 Analytical Laboratory

Laboratory analyses will be performed by Pace Analytical Services, Inc. (Pace) of Huntersville, North Carolina. Personnel organization, responsibility, and training for the laboratory can be found in Pace's Quality Assurance Manual, which is included in Appendix B.

2.2 PROBLEM DEFINITION

Soil and groundwater contamination has been identified at the CTS of Asheville, Inc. Superfund Site. Some residents within a mile of the Site obtain their potable water from water supply wells or springs. The USEPA has been collecting water supply samples from identified wells/springs within an approximate one-mile radius of the Site on a quarterly basis since 2007. As of March 2012, the USEPA has conducted 13 sampling events. Trichloroethene and associated daughter products were identified in several of the sampled water supply wells and those homes have been connected to the municipal water supply.

The objective of the water supply monitoring is to collect water supply samples to monitor potential target chlorinated volatile organic compound (VOC) contamination impacting the residential water supply sources within an approximate one-mile radius of the former plant at the Site.

2.3 PROJECT DESCRIPTION

The project involves collecting water supply samples from privately-owned wells and springs within an approximate one-mile radius of the former plant at the Site. Properties with a potable well or spring will be identified using information from the USEPA's previous sampling activities, and access agreements will be obtained for those properties in which the property owner wants their well or spring sampled. Samples will be collected on a quarterly basis. Water supply samples will be collected in accordance with the procedures described in the FSAP and submitted for analyses of target chlorinated VOCs. The results of the analyses will be compared to applicable regulatory levels for drinking water, which are the federal Maximum Contaminant Levels (MCLs). If constituents are detected above the applicable levels, the USEPA will be notified. The project also includes

preparation of draft transmittal letters for distribution to the property owners by USEPA, and reporting to the USEPA. The draft transmittal letters will be prepared in accordance with "Communicating Environmental Data to Property Owners and Tenants" (USEPA, 2010). A Water Supply Monitoring Report will also be submitted to USEPA after each monitoring event.

The constituents analyzed, frequency of sampling, area and drinking water wells/springs sampled may be modified, as agreed to by USEPA, depending upon the results of the water quality monitoring, implementation of an Interim Response Measure, data produced during the Remedial Investigation, and such other data or information as relevant to determine the necessity and efficacy of the water supply sampling and analysis.

2.4 DATA QUALITY OBJECTIVES

Data collected at a site needs to be of sufficient quality and quantity to support defensible decision making. Data quality objectives (DQOs) are identified before the sampling and analysis begin. DQOs will be used to ascertain the type, quality, and quantity of data necessary to address problems. The USEPA guidance document, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006), outlines the following seven-step process for establishing DQOs:

1. **State the Problem.** Concisely describe the problem to be studied.
2. **Identify the Goal of the Study.** State how environmental data will be used in meeting objectives and solving the problem, identify study questions, and define alternative outcomes.
3. **Identify Information Inputs.** Identify data and information needed to answer study questions.
4. **Define the Study Boundaries.** Specify the conditions (time periods, spatial areas, and situations) to which the decision will apply and within which the data will be collected.
5. **Develop the Analytical Approach.** Define the conditions by which the decision maker will choose among alternative risk management actions. This is usually specified in the form of an "if...then..." statement.
6. **Specify Performance or Acceptance Criteria.** Define in statistical terms the decision maker's acceptable error rate based on the consequence of making an incorrect decision.
7. **Develop the Plan for Obtaining Data.** Evaluate the results of the previous steps and develop the most resource-efficient design for data collection that meets all of the DQOs.

2.4.1 State the Problem

Soil and groundwater contamination has been identified at the CTS of Asheville, Inc. Superfund Site. Some residents within a one-mile radius of the former plant at the Site obtain potable water from water supply wells and springs. Trichloroethene and associated daughter compounds have been identified in several private water supply sources within the one-mile radius and those homes have been connected to the municipal water supply. Water supply samples have been collected by the USEPA from the majority of the water supply wells within a one-mile radius on a quarterly basis since December 2007 and occasional detections of contaminants have occurred. The objective of the water supply monitoring program is to monitor water supply sources within an approximate one-mile radius of the former plant at the Site to determine if target chlorinated VOCs are contaminating water supply sources above applicable regulatory standards.

2.4.2 Identify the Goals of the Study

Based on previous investigations of groundwater at the Site and USEPA's sampling of water supply wells, the target chlorinated VOCs are:

- 1,1-Dichloroethene
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Tetrachloroethene
- 1,1,1-Trichloroethane
- Trichloroethene
- Vinyl chloride

The principal study question the water supply monitoring program addresses is:

- Are target chlorinated VOCs present in water supply wells and/or springs within a one-mile radius of the Site at concentrations that exceed the federal MCL?

If a target chlorinated VOC is present in a water supply sample above the associated MCL, the analytical results will be submitted to the USEPA within 24 hours of receipt and the following alternative actions will be evaluated:

- Supply bottled water to the home(s) that are serviced by the affected water supply source;

- Provide the Interim Response Measure (i.e., water filtration system), to the extent not previously offered and accepted or rejected by the homeowner, to the home(s) that are serviced by the affected water supply source;
- Connect the home(s) to the municipal water supply system; or,
- Take no action.

2.4.3 Identify Information Inputs

The primary information input needed to support the decision making process will be the results of the analysis performed on the collected water supply samples. The analysis is capable of providing results that are lower than the associated MCLs for the constituents to be analyzed. The water supply samples will be submitted for target chlorinated VOCs according to USEPA Method 8260B.

Target analytes and detection limits for the laboratory analytical methods are summarized in Table 1. The laboratory electronic data deliverable (EDD) format is defined in Table 2. Sample collection, preservation, and holding time goals are summarized in Table 3. QC limits for surrogates, spikes, and duplicate analyses are summarized in Table 4.

The constituents analyzed may be modified, as agreed to by USEPA, depending upon the results of the water quality monitoring, implementation of an Interim Response Measure, data produced during the Remedial Investigation, and such other data or information as relevant to determine the necessity and efficacy of the water supply sampling and analysis.

Water quality data will be collected during purging a water supply well to provide “stabilization” data (i.e., to determine when standing water has been purged from the well and “fresh” water from the surrounding formation is entering the well). The following water quality parameters will be measured during purging: pH, conductivity, temperature, and turbidity. QA/QC acceptance criteria for water quality parameters are contained in Section 5.2 of the FSAP.

Historical information and/or analytical data associated with previously-sampled water supply sources in the vicinity of the Site will also be utilized in the decision making process.

2.4.4 Define the Study Boundaries

The water supply monitoring program is limited to the collection of water samples for laboratory analysis to evaluate the possible impact of target chlorinated VOCs on water supply sources. The sampling program includes water supply wells and springs within an approximate one-mile radius of the former plant at the Site where permission to collect samples is granted by the owners. It is possible that not all owners will grant permission to have their water supply source sampled; therefore, there might be some water supply sources where samples will not be collected within the study boundary.

Each water sample represents one sampling unit. Some samples might be collected from the same location, but before and after a Respondent-installed Interim Response Measure filtration system; therefore, the two samples will be treated separately, as the characteristics of the water before and after the filtration system might be different.

Sampling activities will be conducted during the day, from approximately 8 a.m. to 6 p.m. from Monday through Friday. Work will be suspended when severe weather conditions, such as lightning, rain, or snow arise or are forecasted and samples are to be collected outdoors, such as at a wellhead location. Each water quality monitoring event is expected to take approximately one week to complete.

Practical constraints that might interfere with the sampling activities include:

- Well/spring owner is not at home during scheduled appointment time, if appointment is necessary
- Access is denied by well/spring owner
- Well/spring owner requests not to be sampled during a quarterly sampling event
- Sampling port/location is not working properly (e.g., spigot is broken, well pump not turned on)
- Severe weather (thunder, lightning, heavy rain or snow, etc.)

The smallest unit on which a decision might be based is the analytical result for a detected target constituent in one water sample.

2.4.5 Develop the Analytic Approach

The analytical results of target constituents detected in the water supply samples will be compared to their associated MCL. The laboratory methods described in Section 2.4.3

have quantitation limits that are less than the MCLs so that potential contaminants can be detected if they are present at concentrations greater than their associated MCL. If constituents are detected above the MCL, the USEPA will be contacted to determine if confirmation sampling is necessary and/or if response actions are necessary.

2.4.6 Specify Performance or Acceptance Criteria

Data is subject to random and systematic errors at different stages of the collection process and typically include the following components:

- **Sampling Error:** Sometimes called Statistical Sampling Error, is influenced by the inherent variability of the population over space and time, the sample collection design, and the number of samples taken. It is usually impractical to measure the entire population space, and limited sampling may miss some features of the natural variation of the measurement of interest. Sampling design error occurs when the data collection design does not capture the complete variability within the population space, to the extent appropriate for making conclusions. Sampling error can lead to random error (i.e., random variability or imprecision) and systematic error (bias) in estimates of population parameters.
- **Measurement Error:** Sometimes called Physical Sampling Error, is influenced by imperfections in the measurement and analytical system. Random and systematic measurement errors are introduced in the measurement process during physical sample collection, sample handling, sample preparation, sample analysis, data reduction, transmission, and storage.

The water supply study is a systematic study of individual locations and assessment of statistical error is not planned. Measurement error is addressed by establishing standardized methods of sample collection and through the validation of analytical data.

Data from off-Site laboratory analyses will be reviewed and validated as described in Section 5.0. Results will be evaluated based on criteria in the referenced analytical methods and USEPA validation guidelines. Results may be accepted without qualification or with validation qualifiers (e.g., J, UJ). Results that don't meet minimum criteria for acceptance (i.e., qualified as rejected during validation) will be unacceptable for decision making purposes.

2.4.7 Develop the Plan for Obtaining Data

A systematic/judgmental sampling design will be implemented, as samples will be collected from wells/springs that have been previously identified, or are identified in the

future, within an approximate one-mile radius of the former plant building at the Site, and where access for sampling is granted by the well/spring owner. If access is not granted by the well/spring owner, a water supply sample will not be collected from that location. The following steps are included to obtain data:

- Identify sample locations and obtain permission to collect sample
- Collect samples for laboratory analysis
- Obtain analytical results from laboratory and complete data validation
- Compare results to project objectives identified in Section 2.4.2
- Complete actions for individual locations based on analytical data

2.5 METHOD PERFORMANCE OBJECTIVES

Performance objectives are defined for field data and fixed laboratory data. QA/QC acceptance criteria for water quality parameters are contained in Section 5.2 of the FSAP. Method performance objectives for work performed are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity. Target analytes and detection limits are summarized in Table 1. Sample collection, preservation, and holding time goals are summarized in Table 3. Precision and accuracy goals for surrogates, spikes, and duplicate analyses are summarized in Table 4. The following sections describe the method performance parameters and calculations, as appropriate.

2.5.1 Precision

Precision is described as the agreement among a set of duplicate or replicate measurements. Precision is measured using relative percent difference (RPD) for two data points, as follows:

$$RPD = \frac{|X_1 - X_2| \times 100}{(X_1 + X_2) / 2}$$

where: RPD = relative percent difference between duplicate results

X_1 and X_2 = results of original sample and duplicate analyses

$|X_1 - X_2|$ = absolute difference between duplicates X_1 and X_2

2.5.1.1 Field Precision

Field precision is assessed through the collection and measurement of field duplicates (one extra sample in addition to the original field sample). Field duplicates will be collected at a frequency of one per ten investigative samples per matrix/media per analytical parameter. Precision will be measured through the calculation of RPD. The resulting information will be used to assess sample homogeneity, spatial variability of samples, sample collection reproducibility, and analytical variability. The field precision goal is a RPD less than 30 percent.

2.5.1.2 Laboratory Precision

The precision of the analysis can be inferred through one of the following: laboratory control sample duplicates (LCSDs), matrix spike (MS) and matrix spike duplicate (MSD) samples, or unspiked duplicate samples. The laboratory analyzes one or more of these duplicate samples at a rate of one per batch of 20 samples. The MS/MSD samples provide information about the effect of the sample matrix on extraction and measurement methodology. A MS/MSD pair will be analyzed at a rate of one per batch of 20 or fewer investigative samples. The precision of laboratory analyses will be assessed by calculating the RPD for each pair of MS/MSD duplicate samples, laboratory control sample spike duplicates, and unspiked duplicate samples. The laboratory precision goal is a RPD less than 30 percent.

2.5.2 Accuracy

Accuracy is the degree of agreement between a measurement or observation and an accepted value.

2.5.2.1 Field Accuracy

Field accuracy, assessed through appropriate field equipment and trip blanks, is achieved by adhering to sampling, handling, preservation, and holding time requirements. A material blank sample from the source water used to decontaminate field instruments or equipment will be analyzed to check for possible procedural contamination that could be introduced to samples. It is anticipated that the majority of samples will be collected directly from a tap/spigot at the wellhead and that no equipment decontamination will be necessary. However, the use of a sample collection scoop or bowl may be needed at some locations and decontamination of the collection device may be necessary. An

equipment rinsate blank would be collected to assess the adequacy of decontamination of such a sampling device. Trip blanks will be used to assess the potential for contamination of samples due to migration of contaminants (e.g., VOCs) during sample shipment, handling, and/or storage. Accuracy of field instruments is assessed by daily instrument calibration and calibration checks.

2.5.2.2 Laboratory Accuracy

Laboratory accuracy is assessed by analyzing matrix spikes and laboratory control samples (LCS). The results are expressed as a percent recovery. Surrogate recoveries may also be used to assess accuracy. Method blanks are used to assess possible contamination from laboratory procedures. Laboratory control samples, method blanks, and preparation blanks will be analyzed at least once with each analytical batch, with a minimum of one for every 20 samples. The percent recovery (% recovery) is calculated with the following equation:

$$\% \text{ recovery} = \left(\frac{X - B}{T} \right) \times 100$$

where: X = measured amount in sample after spiking

B = background amount in sample

T = amount of spike added

Accuracy control limits are included in Table 4.

2.5.3 **Representativeness**

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter used to evaluate the efficacy of the sampling plan design. Representativeness is demonstrated in the project planning documents by providing full descriptions of the sampling techniques and the rationale used for selecting sampling locations. The measure of representativeness is established during preparation of the sampling and analysis approach and rationale, and then reassessed during the data usability process.

In general, representativeness in the field will be maximized by following SOPs, proper sample collection procedures, proper sample preservation procedures, and utilizing

experienced/trained sampling personnel. Representativeness in the laboratory will be maximized by using the proper analytical procedures, appropriate laboratory methods, and meeting sample holding times.

2.5.4 Completeness

The goal of the water supply monitoring program is to obtain field samples and usable laboratory data from water supply sources identified in the monitoring plan that have granted access for sampling. After the completion of each monitoring event, an assessment of sampling completeness will be done to identify any residences or sample locations where samples were not obtained. A second evaluation of completeness will be done upon completion of data validation to determine if usable data were obtained from the laboratory for each sampled location. If usable data are not obtained from each sampled locations during that monitoring event, an evaluation will be conducted to determine the impact of missing data on the assessment of potential contamination at the missing locations. Because this is a quarterly sampling program, it is unlikely that recollection of missing samples will be required. However, recollection of samples might be needed on a case-by-case basis after assessment of available data from other sample locations.

2.5.5 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Throughout sampling on this project, standard methodologies as discussed in the FSAP and in this QAPP will be used for both sampling and analysis activities to insure comparability. The intention is to use the same laboratory (Pace) for standard analyses throughout the duration of the water supply monitoring program and there should not be a need to assess the comparability of data from different laboratories.

2.5.6 Sensitivity

Sensitivity is the capability of a test method or instrument to quantify sample results at levels consistent with the project objectives. The analytical methods selected for this investigation will provide data at limits sufficient to determine the presence or absence of contamination in water supply samples at low levels. Although there is no single definition of this term, the following terms and definition of detection limits will be used:

- Method detection limit (MDL) is a statistically determined concentration. It is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero as determined in the same or a similar matrix. Because of the uncertainty of accuracy and precision in this range, sample results greater than the MDL but less than the practical quantitation limit will be reported as estimated and flagged with a "J."
- Practical quantitation limit (PQL) is the concentration of the target analyte that the laboratory has demonstrated the ability to measure within specified limits of precision and accuracy during routine laboratory operating conditions. This value is variable and highly matrix-dependent. It is the minimum concentration that the laboratory will report as unqualified.

Laboratory detection and quantification limits are presented in Table 1. The laboratory PQLs and MDLs were compared to applicable MCLs, where established for the constituents to be analyzed. The PQLs are less than the associated MCLs for constituents to be analyzed.

2.6 SPECIAL TRAINING/CERTIFICATION

Training of field personnel for the tasks associated with the Work Plan will be provided by the FOL. Routine training will be completed at the beginning of each field event, if required. The FOL will review applicable procedures with each field personnel to verify that the project requirements and procedures are understood and implemented properly.

The laboratory will maintain a North Carolina Wastewater/Groundwater Laboratory Certification, which is applicable to the analytical methods that will be performed during implementation of the Work Plan. Field personnel will review and follow manufacturer's operating procedures for field equipment, such as the water quality meter.

Personnel conducting work at the Site will be appropriately trained in health and safety procedures. If appropriate, personnel conducting work covered by this QAPP will have obtained at a minimum, the 40-hour hazardous waste-site worker training program and the 8-hour annual refresher course in compliance with regulations stated in 29 CFR Part 1910.120. Certificates or documentation representing completion of training shall be maintained in personnel files. The Project Manager or FOL will verify that personnel have the necessary training and certifications prior to the implementation of the project.

A Site HASP has been developed specific to the Site activities discussed in this QAPP. The HASP applies to AMEC employees and AMEC subcontractors, only. Each field team will have a copy of the HASP during field activities. Personnel implementing the water supply monitoring activities will be required to read, understand, and conform to the requirements of the HASP. If new information arises, the HASP will be updated, as necessary, to ensure compliance with the Occupational Safety and Health Act (OSHA) and safe working conditions.

2.7 DOCUMENTS AND RECORDS

Critical records for the work will be maintained in AMEC's Asheville, North Carolina, office. File maintenance will be under the direct control of the Project Manager. Project records will be organized with a project-specific file and document numbering system in accordance with AMEC protocols.

The anticipated project records include:

- Project log book(s)
- Field data records
- Safety records, as specified in the Site HASP
- Chain of custody records
- Laboratory reports

The anticipated electronic records include:

- Laboratory electronic data deliverables (EDDs)
- Final validated laboratory analytical results
- Surveying data
- Photographs (digital)

The electronic records will be stored on AMEC's Asheville, North Carolina office server, which is backed up daily. Electronic data will be available to other AMEC office servers, as necessary for data validation, presentation, etc.; however, the original data documents will be stored on the Asheville server.



The off-Site laboratory (Pace) will submit analytical results in hard copy and electronic formats. The electronic data will be submitted as EDDs in accordance with the format described in Table 2. The analytical results will be imported into the AMEC Technical Environmental Database (TED). The TED is an Oracle-based relational database designed with using Microsoft-structured query language. The TED is used to manage and store a variety of records generated during field investigations, including sample location information and analytical data. The TED can provide output files, such as Excel, for use in data validation and subsequent importation of data qualification actions. A variety of data output formats are available including sample results summary tables, summaries of data qualification actions, trend analysis for long term monitoring programs, and queries used to generate figures and tables in contamination and risk assessments. The TED data are permanently stored on a secure AMEC server that is backed up daily.

If this QAPP, or the associated Work Plan or FSAP, is updated/modified, the updated version(s) will be distributed to those persons identified in the distribution list. If the modifications are minor, then only the portions of the document with the modifications will be disturbed; otherwise, the entire document(s) will be distributed. Project documents and records will also be scanned and saved in a project-specific data directory on the AMEC server. Data and document management is further discussed in Section 3.11.

Retention of files will be in accordance with the Settlement Agreement, which requires the preservation and retention of records and documents during the pendency of the Settlement Agreement and for a minimum of fifteen years after completion of construction of any remedial action.

3.0 MEASUREMENT AND DATA ACQUISITION

The following sections describe the design and implementation of measurement procedures and discuss the methods to be used for sampling, analysis, data handling, and QC in support of the tasks performed.

3.1 SAMPLING PROCESS DESIGN

The Work Plan for Monitoring of Drinking Water Wells describes the proposed sampling plan, including planned sampling locations, rationale for the sampling locations and measurement methods, the media to be sampled, and measurements that will be taken.

The USEPA has been collecting water supply samples from identified wells/springs within an approximate one-mile radius of the Site on a quarterly basis since 2007. As of March 2012, the USEPA had conducted 13 sampling events. The USEPA has conducted several water supply well/spring surveys to identify residences that obtain their drinking water from a well or spring. The USEPA has identified approximately 129 water supply wells within an approximate one-mile radius of the Site (the actual number will be provided to AMEC prior to initiating sampling). The USEPA collects samples where permission by the well owner is granted. Not all wells have been sampled during all the sampling events.

Water supply samples will be collected from water supply wells and springs within an approximate one-mile radius of the former plant at the Site where access to collect the samples has been granted by the well/spring owner. Water supply wells/springs will be identified using information collected during previous quarterly sampling events conducted by USEPA. The monitoring strategy will be performed as described in the Interim Response Measure Work Plan to Supplement the Removal Action Plan of February 4, 2005.

Procedures for water supply well/spring sampling, surveying, decontamination, and management of investigation derived waste are described in the FSAP.

3.2 FIELD SAMPLING DOCUMENTATION

Documentation of field activities will be completed using a combination of logbooks, FDRs, and sample custody records. Field logbooks are completed to provide a general record of activities and events that occur during each field task. FDRs have been designed for exploration or sample collection tasks, to provide a complete record of data obtained during the activity. Examples of FDRs that will be used during the water supply monitoring program are included as Appendix C.

Deviations from the procedures specified in the QAPP and the FSAP will be documented in the field logbook and applicable FDRs. Such deviations may be dictated by Site-specific conditions encountered during the sampling activity.

3.2.1 Field Logbooks

The field logbooks provide a daily hand written account of all field activities. Logbooks will be permanently bound and entries will be made in permanent black or blue ink, and corrections will be made with a single line with the author's initials and date. Each page of the logbook will be dated and signed by the person completing the log. Partially completed pages will have a line drawn through the unused portion at the end of each day. The following information will generally be entered into the field logbooks:

- Project name and number
- Date and time of each entry
- Weather conditions anticipated for the day, or as weather conditions change
- Site personnel and their responsibilities
- Descriptions of important tasks or subtasks
- A description of samples collected (if not documented on a FDR)
- Documentation of equipment maintenance and calibration activities (if not documented on a FDR)
- Documentation of equipment decontamination procedures
- A summary of problems encountered during the day, including cause of problem and corrective actions implemented

3.2.2 Field Data Records

Field data records contain sample collection and/or exploration details. Examples of FDR forms anticipated to be used during implementation of the Work Plan are contained in

Appendix C. FDRs are completed in the field by field personnel at the time testing/sampling is done. The goal of the FDR is to document exploration and sample collection methods, materials, dates and times, and sample locations and identifiers. Field measurements and observations associated with a given exploration or sample collection task are recorded on the FDR. FDRs are maintained throughout the field program in files that become a permanent record of field program activities. A listing of FDRs anticipated for the water supply monitoring program is presented below.

- Instrument calibration records
- Water supply well sampling records
- Water supply spring sampling records
- Sample summary record (summary for each quarterly monitoring event)

3.3 SAMPLE HANDLING AND CUSTODY

The following sections describe how samples will be identified, contained, packaged, transported, and tracked during sampling and analysis activities. The FOL will maintain the field log book and will be responsible for sample custody in the field.

3.3.1 Sample Designation

Samples will be designated on the basis of sample type (e.g., field sample, QA/QC sample) and associated station identification number. Station identification numbers will be the same as those used by the USEPA and the USEPA will provide the station identification numbers and associated addresses prior to initiating a sampling event. The station identification number will remain the same for a particular sampling location throughout the duration of the water supply monitoring program. If a location is removed from the water supply monitoring program, or not included in a particular monitoring event, the corresponding location number will not be reused during subsequent water supply monitoring events. Similarly, if a water supply monitoring location is identified and added to the monitoring program, the location identification will be next sequential number in the list of monitored locations.

Field samples will be designated with the water supply location type (i.e., well or spring), the predetermined location identification number, and the quarter sampled. For example, the water supply sample collected from a well at station 50 during the fifth quarterly water

supply monitoring event will be designated as “PW-50-05”, where “PW” indicates private well. If more than one sample is collected at a sampling location (e.g., pre- and post-filtration system), then a letter will be indicated at the end of the sample name. For example, if pre- and post-filtration system samples were collected at location 50 during the fifth quarterly monitoring event, the samples would be designated as “PW-50A-05” and “PW-50B-05.” Water supply spring samples will be designated similarly, but will begin with “SPR.”

The QC samples will be cross-referenced on the sample FDRs or in the field log book. The QC samples will have a prefix identifying their purpose, followed by the sequential number and quarter, as follows:

- FD-01-01 (field duplicate)
- EB-01-01 (equipment blank)
- TB-01-01 (trip blank)
- MB-01-01 (material blank)
- MS/MSD samples will be identified on the chain of custody forms in the comments

Each sample submitted for analysis at the laboratory will be identified with a unique identification number (sample ID). These sample ID will be tracked from collection through laboratory analysis and into the final reports. The sample IDs will be recorded on a FDR during the sampling activities.

The sample data will be recorded on FDRs or in the field logbook with sample designation information while in the custody of the sampling team. A waterproof label backed with a water-resistant adhesive will be completed and attached to each sample container. Labels will be completed using waterproof ink, and will contain at least the following information:

- Project name or number
- Date and time of sample collection
- Sample identification number
- Preservatives, if applicable
- Sampler’s initials
- Analyses to be conducted

3.3.2 Sample Collection and Preservation

Sample container and preservation requirements for samples submitted for analysis are summarized in Table 3. Sample container requirements are based on specifications from the referenced analytical methods. The analytical laboratory may substitute other containers depending upon laboratory stock at the time of the sampling event; however, bottle type and preservative will not change. Samples will be collected in laboratory-supplied containers.

3.3.3 Sample Packaging and Shipment

Sample containers will be sealed in bubble-wrap and/or plastic sealable bags and placed into an iced cooler for shipment to the laboratory. The contents of the cooler will be placed in a plastic bag to minimize leakage of water from the cooler. Containers will be packed tightly so that movement of the containers is minimized. Appropriate packaging materials (e.g., Styrofoam, "bubble wrap") will be used if needed. Ice will be placed in the cooler, generally around the sample containers, so that the samples are maintained at four degrees Centigrade ($^{\circ}\text{C}$) [$\pm 2^{\circ}\text{C}$]. Temperature blanks will be included in each cooler submitted to the laboratory. The COC will be placed in a sealable plastic bag and affixed to the underside of the cooler lid. The cooler will be securely closed with packaging tape to prevent the cooler from opening during transport.

Custody seals, preprinted, adhesive-backed seals designed to break if disturbed, will be placed on the cooler prior to shipment to provide security. The custody seals will be signed and dated before leaving AMEC's possession. Upon receipt by the laboratory, the sample custodian will confirm that the seals on coolers are intact or notify the Project Manager or FOL if any custody seals have been broken.

Regulations for packaging, marking/labeling and shipping hazardous waste materials and waste are issued by U.S. Department of Transportation (USDOT). Air carriers which transport hazardous material, such as Federal Express, may also require compliance with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations. Current IATA Regulations will ensure compliance with USDOT protocol.

3.3.4 Chain-of-Custody Records

The COC will be placed in a sealable plastic bag and affixed to the underside of the cooler lid. An example of the Pace's COC is on page 104 of Pace's QAM (Appendix B). The sampling personnel will retain a copy of the COC. The custody record will include the following information:

- Name of person collecting the samples
- Date and time samples were collected
- The media sampled
- Type of sampling conducted (composite/grab)
- Sample ID
- Number and type of containers used
- Sample preservation
- Analyses requested
- Signature of the sampling person relinquishing samples to a non-sampling person (such as a Federal Express agent or laboratory courier), with the date and time of transfer

In addition, if samples are known to require expedited turnaround in the laboratory due to project time constraints or analytical concerns such as extraction time or sample retention period limitations, the person completing the COC record will note these constraints in the remarks section of the custody record and will notify the Laboratory Project Manager of the expedited turnaround requirement.

3.3.5 Laboratory Custody Procedures

Information regarding the laboratory's sample receipt, handling and custody procedures are presented in Pace's QAM (Section 2.0). Below is a brief overview of lab custody procedures.

Upon arriving at the laboratory, samples are logged in by a designated sample custodian giving each sample a unique ID code. Sample receipt protocols and storage conditions include the following:

- Determine if the temperature requirement has been maintained during shipment, notifying the Laboratory Project Manager if the temperature requirements have not been maintained, and documenting on the cooler receipt form and COC.

- Verify samples received are listed in the COC. Notify Laboratory Project Manager if not listed.
- Verify all sample holding times have not been exceeded. Notify Laboratory Project Manager if hold times have been exceeded.
- Examine shipping records for accuracy and completeness.
- Sign COC and attach the waybill.
- Note any other problems with the coolers and samples on the cooler receipt form, specifically with preservation and contact the Laboratory Project Manager if problems are identified.
- Log samples into the Master Logbook and into the Laboratory Information Management System, and attach the laboratory sample numbers to each sample bottle.
- Place the samples into proper laboratory storage.

The Laboratory Project Manager will send a copy of the laboratory sample receipt form via email to the AMEC Project Manager, or an acceptable representative, and AMEC will verify that the samples were received intact and properly preserved. The laboratory will also generate an intra-lab COC that will be maintained while the samples are being analyzed and remain in lab custody. This ensures that the samples are maintained at the proper storage temperature, and that the sample integrity is maintained through adequate protection from contamination from outside sources or from highly contaminated samples.

Holding times are the responsibility of the laboratory for samples received within 48 hours of sampling or if less than half of the holding time has passed. If a holding time is exceeded, the laboratory will identify and document the root cause of the failure, and will contact the Laboratory Project Manager.

3.4 ANALYTICAL METHOD

Target chlorinated VOCs in water matrices and associated QC samples will be analyzed by EPA Method 8260B or latest version. Water samples will be prepared using EPA Method 5030 (purge-and-trap). The VOCs are introduced into the gas chromatograph by purge-and-trap Method 5030 (aqueous samples). Analytes eluted from the capillary column are introduced into the mass spectrometer. Identification of target analytes is accomplished by comparing their mass spectra with the electron impact spectra of certified standards. Quantitation is accomplished by comparing the response of a major

(quantitation) ion relative to an internal standard with a five-point calibration curve. Table 4 contains a summary of the project quality control limits for the analytical method.

3.5 FIELD QUALITY CONTROL

The field quality control program ensures that samples collected are representative of the media being sampled and that the data generated are valid. Field quality control will be accomplished through:

- Accurate record keeping in the field logbooks and FDRs
- Proper calibration of field equipment according to manufacturer's instructions
- Collection and analysis of QC samples potentially including field duplicates, material blanks, equipment blanks, trip blanks, and duplicate MS/MSD samples

Project QC goals for duplicate and spike samples are summarized in Table 4. QC blank data will be reviewed during data validation to assess possible impacts of field or lab contamination on sample results. Problems that require corrective action may be encountered in the field. Findings that require corrective action will be communicated to the Project Manager and documented in the field log book. The Project Manager will confirm that corrective actions have been implemented and that the problem has been resolved. If more easily addressed problems are encountered in the field, such problems will be addressed and the corrective action noted in the field log book. If an error is made on an accountable document assigned to one individual, that individual will make all corrections by crossing a line through the error, entering the correct information, and initialing and dating the correction. The erroneous information will not be obliterated. The person who made the entry will correct any subsequent error discovered on an accountable document.

The following sections describe quality control samples that will be collected during implementation of the Work Plan for Monitoring of Drinking Water Wells.

3.5.1 Field Duplicates

Field duplicates are two samples taken from the same location at the same sampling time, but submitted to the laboratory as a separate sample and analyzed separately. Aqueous duplicates will be collected by alternately filling sample containers from the same sampling

device for each parameter. Field duplicates will be collected at a frequency of ten percent per analysis for each analytical method. The acceptance criteria (RPD) for field duplicate samples is less than 30 percent.

3.5.2 Equipment Blanks

A rinsate blank, commonly referred to as an equipment blank, is used to demonstrate the effectiveness of field cleaning/decontamination procedures. Contaminant-free water is poured over the equipment that has been cleaned in the field and is collected in the appropriate sample containers. If non-dedicated sampling equipment is employed during the water supply monitoring activities, one equipment blank will be collected per week of use. The analytical results of equipment blank samples will be evaluated during the data validation process to determine the representativeness of the field sample results and to determine if data qualification actions are necessary.

3.5.3 Trip Blanks

A trip blank is utilized to detect possible VOC contamination of samples to be analyzed for VOCs. VOCs are susceptible to contamination by introduction or migration of contaminants through the vial septum. Trip blanks will be prepared by filling volatile vials with purged organic-free water. The trip blanks will be prepared in the laboratory and will accompany the sample containers during transit, during sampling activities, and during storage with the collected samples prior to analysis. Trip blanks will be shipped with each cooler containing samples collected for VOC analysis. The analytical results of trip blank samples will be evaluated during the data validation process to determine the representativeness of the field sample results and to determine if data qualification actions are necessary.

3.5.4 Temperature Blanks

A temperature blank is a small sample bottle filled with distilled water that is placed in each cooler submitted to the laboratory. Upon arrival at the laboratory, the temperature of this vial is measured and recorded to determine compliance with the preservation requirements of the analytical methods. The temperature blank is not analyzed and does not measure introduced contamination.

3.5.5 Material Blanks

Material blanks are used to determine if the source water used for decontamination contains constituents that are being analyzed for in the field samples. During each quarterly water quality monitoring event, a material blank will be collected from the decontamination water source, if decontamination procedures are conducted on sampling equipment, and submitted for the same analyses as the field samples. The analytical results of material blank samples will be evaluated during the data validation process to determine the representativeness of the field sample results and to determine if data qualification actions are necessary.

3.5.6 Matrix Spike and Matrix Spike Duplicate Samples

MS/MSD samples are additional samples collected with the field samples, and spiked by the laboratory and analyzed according to standard laboratory procedures. They are collected at a frequency of one MS/MSD pair per twenty environmental samples of the same matrix. MS/MSD samples also provide field precision data. The acceptance criteria (RPD) for MS/MSD samples is less 30 percent.

3.6 LABORATORY QUALITY CONTROL

Laboratory performance will be monitored by the inclusion of various internal QC checks that allow an evaluation of method control (batch QC) and the effect of the sample matrix on the data being generated (matrix-specific QC). The overall data quality objectives are to implement procedures for the laboratory analysis and reporting of the data that are indicative of the degree of quality consistent with their intended use. Laboratory batch QC samples consist of method and instrument blanks, laboratory control samples, and calibration verification samples. Matrix specific QC samples consist of MS/MSDs, sample duplicates, and the use of surrogate compounds and internal standards. Pace's QC procedures are included in Section 4.0 of their QAM (Appendix B).

3.7 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

The primary objective of an instrument/equipment testing, inspection, and maintenance program is to help ensure the timely and effective completion of a measurement effort by minimizing the downtime of sampling and/or analytical equipment due to component

failure. Testing, inspection, and maintenance will be carried out on field and laboratory equipment in accordance with manufacturer's recommendations and professional judgment.

3.7.1 Field Equipment

It is expected that some, if not all, equipment used during implementation of the Work Plan will be rented from an environmental equipment supplier. Preventative maintenance of field measurement instrumentation and equipment will be performed according to the procedures presented in the manufacturer's instructions.

The field staff and/or subcontractors will be responsible for ensuring instrumentation is operating properly prior to use. Prior to sample collection each day, field instruments will be calibrated and calibration check standards will be analyzed. A summary of calibration check standard criteria is contained on the Field Instrument Calibration Record found in Appendix C. If problems are encountered, they will be communicated to the FOL and documented in the field logbook. The faulty instrumentation/equipment will be scheduled for repair and then sequestered and tagged until repaired and qualified for re-use.

3.7.2 Laboratory Equipment

Testing, inspection, and maintenance of laboratory instruments/equipment will be conducted in accordance with the procedures specified in Section 6.4 of Pace's QAM (Appendix B).

3.8 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

General guidance regarding calibration and frequency of calibration of field and laboratory equipment are described in the following sections.

3.8.1 Field Equipment

Field equipment that will require calibration during the water supply monitoring program includes the water quality meter (pH, conductivity, and temperature) and the turbidity meter. Prior to sample collection each day, field instruments will be calibrated. A summary of calibration check standard criteria is contained on the Field Instrument Calibration

Record found in Appendix C. Field equipment used during environmental sample collection activities will be subject to the following calibration requirements:

- Identification. The manufacturer's serial number will be used to uniquely identify the equipment.
- Standards. Equipment will be calibrated against reference standards having known valid relationships or accepted values. Frequency. Field equipment will be calibrated at prescribed intervals and/or prior to use. Frequency will be based on the type of equipment, inherent stability, manufacturers' recommendations, intended use, and experience.
- Records. Calibration records will be maintained for field equipment used on the project (Appendix C).

If field equipment is found to be out of calibration, an evaluation will be made and documented to determine the validity of previous measurements and/or corrective action will be implemented

3.8.2 Laboratory Equipment

The calibration of laboratory instruments and support equipment is necessary to ensure that the analytical system is operating correctly and functioning within the guidelines of precision, accuracy, and sensitivity. The frequency and type of calibration for laboratory equipment/ procedures and control limits/acceptance criteria are presented the laboratory quality plans

Reference standards are used to calibrate the equipment. Physical reference standards include weights for scales and balances, and certified thermometers for calibrating working thermometers. Chemical reference standards include reference materials traceable to recognized standards suppliers, and are generally associated with normal instrument calibrations. The standards must be verified by quantitation against a second known standard before the data is reported, and must meet specified QC criteria for calibration verification.

At minimum, the laboratory equipment must be calibrated and maintained at intervals prescribed by the method. An instrument is said to be calibrated when an instrument response can be directly related to the concentration of an analyte graphically through the use of a calibration curve. The low standard of the curve shall be established by the laboratory as the PQL. Results above the highest standard will be diluted into the

calibration range and reanalyzed. Laboratory calibration procedures are described in Section 6.2 of Pace's QAM (Appendix B).

3.9 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Supplies and consumables that are anticipated to be used during water supply monitoring program include containers, calibration solutions, decontamination supplies, potable water, ice, and organic-free water. Sample containers will have certification papers for each lot that is used. The field samplers will inspect containers to verify that containers are not broken and that caps fit securely. If dirt or foreign material is observed in the container, they will be replaced with a new container. Calibration solution certifications will be reviewed to ensure that they are at the concentration ranges specified for the project and that they are within their expiration dates. Certification records will be maintained in the project files. The remaining supplies will be accepted based on judgment of the field personnel. Project team members obtaining supplies and consumables are responsible for confirming that the materials meet the required specifications, are intact and in good condition, are available in adequate supply, and are stored appropriately until use. Project team members will direct any questions or any identified problems regarding supplies and consumables to the FOL for resolution.

3.10 NON-DIRECT MEASUREMENTS

For the purposes of the water supply monitoring program, non-direct measurements will include information/data from previous investigation reports, such as well construction information. This information will be appended to non-direct measurements to ensure data quality is communicated and understood before use.

3.11 DATA MANAGEMENT

The objective of data management is to establish procedures to be used during field investigations for documenting, tracking, and presenting investigative data. Data generated during the field investigations, as well as previously existing data, form the basis for developing conclusions and recommendations. Efficient utilization and comprehensive consideration of available data requires that the data be properly organized for review. Organization of the data will be planned prior to collection to assure

the generation of identifiable and useable data. This section describes procedures necessary to provide for collecting sufficient data to accurately validate raw data and to transfer validated data to a data management system through which it can be evaluated with minimal effort. This section also describes the operating practices to be followed by personnel while collecting and reporting data.

3.11.1 Field Investigation Data

The following data will be collected in the field and maintained in the project file:

- A summary spreadsheet of samples collected during each monitoring event
- Private Well Purge/Sample Collection Records
- Surface Water/Spring Sample Collection Records
- Field Equipment Calibration Records
- COC records

The flow of data for the project will be as follows:

- Field data sheets, including COCs, will be forwarded to the FOL.
- Samples will be sent directly from the field to the selected laboratory.
- Laboratory results, including EDDs and hard copies, will be sent to the FOL; the FOL will forward the laboratory results, including EDDs to the Quality Assurance Manager.
- The Data Reviewer will perform data validation with oversight by the Quality Assurance Manager. The validated data will be transferred in electronic format to the FOL.

3.11.2 Off-Site Laboratory Data

The laboratory will provide a hardcopy analytical report to document the chemical testing and report analytical results. Data deliverables will include sample result and QC summary forms and all supporting raw data needed to verify sample results. For USEPA SW-846 methods used in this investigation, forms similar to those defined under the USEPA Contract Laboratory Program (CLP) deliverables will be required. The laboratory can use customized reporting forms providing they contain equivalent information as CLP forms.

At a minimum, the data packages from the laboratory will include the following:

- Data package narrative
 - summary of analytical methods used
 - correlation of field sample identifications and laboratory sample identifications
 - data qualifier definitions
 - deviations from established QA/QC procedures with corrective action
- Sample results
 - project name
 - field sample identification
 - lab ID
 - unit of measurement
 - batch number
 - collection/extraction/analysis dates
 - detection limits
 - dilution factors
- Sample documentation
 - original chain-of-custody
 - shipping documents
 - cooler receipt forms
- Quality Assurance/Quality Control
 - spike recoveries (surrogates, MS/MSDs, LCSs)
 - internal standard summary
 - initial calibration summaries
 - GC/MS tuning summaries
 - continuing calibration summaries
 - QC blank summaries
 - CLP Form 10 – dual column summary (applicable GC methods)
 - measures of precision (laboratory duplicates, MS/MSDs)
 - control limits for accuracy and precision
- Raw data including instrument printouts (run sequence/acquisition files, chromatograms and quantitation reports), instrument logbook pages, and sample preparation logs.

Sample results will be provided by the laboratory in both electronic and hard copy format. Hard copy and EDDs from the laboratories will be transmitted to the Quality Assurance Manager and Project Chemist. The electronic data will be provided in a format described in Table 2. Electronic lab results will be imported into the AMEC TED. Files of the unvalidated electronic data are provided to the Project Chemist for used during data

validation. The project chemist will make any necessary data qualification and changes based on the data validation review, and qualified results are entered back into the TED. During data validation a quality assurance review of sample results will be completed to ensure that the data in the database match the hard copy provided by the laboratory.

Final validated laboratory data will be maintained in the TED to allow easy retrieval of information and electronic transfer of the data to other parties. Once final data are entered into the TED and validation is completed, data reports will be generated as needed to support contamination assessments and report preparation.

Upon completion of the field investigation and subsequent validation of off-Site laboratory data, an EDD will be prepared with relevant field information and laboratory data in the format specified for environmental data in the Region 4 Science and Ecosystem Support Division (SESD) database (Data Archival and ReTrieval – DART or Equis Pro interface). This database is the Region 4 repository for storing Superfund data, which includes location, geological, and analytical data. Data will be submitted in accordance with the Environmental Data Submission Guideline SESDGUID-106-RO (USEPA, 2010).

4.0 ASSESSMENT AND OVERSIGHT

Internal and external checks (assessments) have been built into this project to assure the following:

- Elements of this QAPP have been properly implemented as prescribed
- The quality of the data generated is adequate and satisfies the DQOs that have been identified in this QAPP
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed

Formal audits are not planned for this program. The FOL will provide training and oversight to field crews and review field records on a daily basis to verify that sample collection procedures and record keeping steps are being completed in accordance with the FSAP and QAPP. The USEPA may complete reviews and audits of the field sampling events at any time during the monitoring program.

If deviations from the Work Plan, this QAPP, or the FSAP are identified, the information will be verbally reported to the Project Manager and noted in the field logbook. Based on the severity of the deviation, the Project Manager might request formal documentation of the deviation in the form of a memorandum to the project file. The Project Manager will determine the timeframe required for corrective action, if corrective action is necessary. Corrective actions will be completed and an assessment of the potential impact on data quality will be made. Project reviews and summaries of issues requiring corrective actions will be summarized in the Site logbook. If potential impact to data quality is identified, a summary of the issues, corrective actions, and impacts to data will be provided to the Quality Assurance Manager for use during the validation of the analytical data. Impacts to data use will be identified in data quality reports prepared for each sampling round.

5.0 DATA VALIDATION AND USABILITY

Data validation involves reviewing and accepting, qualifying, or rejecting data based on requirements in the referenced analytical methods, data validation guidelines, and QC goals established for this project in Section 2.5. Data validation will be conducted based on procedures in the USEPA Region 4 guidelines (USEPA, 2008). Validation guidelines will be modified based on USEPA SW-846 methods used in this investigation. Project QC limits identified in Table 4 will be used to evaluate sample results during validation. Validation will be performed by the Project Chemist, under the direction of the Quality Assurance Manager.

Data validation will consist of a systematic review of the analytical results and associated QC methods and results. In any area not specifically addressed by USEPA guidelines, best professional judgment will be utilized and described in the Usability Assessment portion of the data validation report.

In general, data validation will include a check of data completeness for data in each data package, a transcription check for sample results, and a thorough review of laboratory reporting forms. Specifically, this review will include the following:

- Data package completeness
- Required reporting summary forms to determine whether the QC requirements were met and to determine the effect of QC requirements on the precision, accuracy, and/or sensitivity of the data
- Additional QA/QC parameters, such as field duplicates and equipment blanks to assess the technical usability of the data
- Application of standard data quality qualifiers to the data

In addition, each data validation effort will include a comprehensive review of the following data quality indicators:

- Sample collection, preservation, and holding times (to assess potential for degradation that could affect accuracy)
- Blanks (to assess cross-contamination)
- Surrogate/system monitoring compounds (to assess method accuracy)
- Laboratory control samples and matrix spike/matrix spike duplicate samples to assess accuracy of a method and precision of the method relative to the specific sample matrix, if applicable)

- Instrument tuning and calibration
- Compound quantitation limits and method detection limits (to assess sensitivity compared to project-specific requirements)
- Field duplicate relative percent differences (to assess precision of the method relative to field sampling techniques, the specific sample matrix, and representativeness of the sample aliquot to the area sampled, if applicable)

Analytical results may be qualified by the data validator based on actions described in the USEPA validation guidelines or professional judgment. Results may be accepted without qualification or with validation qualifiers (e.g., U, J, UJ, N). Results that don't meet minimum criteria for acceptance (i.e., qualified as rejected during validation) will be unacceptable for decision making purposes. At a minimum, data rejection criteria identified in the USEPA validation documents will be applied to results.

The following validation qualifiers may be applied to sample results:

- U = target analyte is not detected above the associated detection limit
- J = the reported sample concentration is an estimated value
- UJ = the reported quantitation limit is an estimated value
- N = there is uncertainty in the identification of the reported analyte
- R = constituent rejected and unusable for detect and non-detects

The results of the data validation and any corrective actions implemented will be recorded on a QA/QC worksheet, which will be initialed and dated by the data reviewer. The Quality Assurance Manager or appropriate designee will provide secondary review of the QA/QC worksheet and will also initial and date the worksheet. The initialed and dated QA/QC worksheet will be attached to the final analytical laboratory report that is retained in the project files.

Full validation including raw data verification and calculation checks will be completed on approximately ten percent of the samples. If, during full validation, significant errors are discovered in the QC summary forms, calculations, or data reporting, full validation will be performed on a larger subset of data packages and raw data will be examined.

Results will be qualified using general procedures described in the USEPA validation guideline and the judgment of the project chemist. Upon completion of the validation task,

a report will be prepared. Validation reports will be organized by sample collection task and may include be designed to report on multiple sample delivery groups. The validation report(s) will include the following information:

- Identity of the laboratory used for analysis
- A summary of analytical methods
- A summary of samples that are included in the sample set
- A discussion of data validation actions, qualifications, and observations
- A tabulation of validated samples results

Qualifiers applied to the data during validation will be entered into the electronic data deliverables in the database.

6.0 RECONCILIATION OF DATA TO PROJECT OBJECTIVES

At the end of each sampling event, an assessment of field records, field data, laboratory analytical data usability, and project completeness will be conducted to determine if project objectives defined in the FSAP and QAPP have been met. The FOL and Project Manager will review field records and reports to verify completeness of field records and identify any issues regarding project procedures, collection of field data that did not meet quality objectives, the completeness of the samples collected, or corrective actions. A review of the data validation report associated with the laboratory data will also be completed by the Quality Assurance Manager in cooperation with the FOL and Project Manager to identify data that is qualified. An assessment of impacts of field issues of data qualification action will made and documented in a data usability report that will be prepared for each monitoring event. Impacts might include identification of entire samples or a subset of analytes where data are considered unusable. In other cases, uncertainties in the accuracy of usable data might be identified.

In the Water Supply Monitoring Reports, a data quality and completeness summary will be provided that identifies data gaps or analytical data quality issues that are identified in field operation reports or analytical data validation reports. The following items will be included in the data usability summary:

- Field investigation scope modifications
- Field investigation data quality issues
- Field investigation data gaps (data that was planned and not obtained)
- Field and analytical data completeness
- Analytical data validation qualification actions and impacts on data usability
- Analytical detection limits and impacts on data usability

The need for recollection of sample or other actions related to the data usability will be determined on a case by case basis with input from the USEPA Project Manager.

7.0 REFERENCES

- USEPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4), EPA/240/B-06/001, February 2006.
- USEPA, 2008. Data Validation Standard Operating Procedures for Organic Analyses; USEPA Region 4, Science and Ecosystem Support Division Quality Assurance Section, MTSB; Athens, Georgia; August 2008.
- USEPA, 2010. Environmental Data Submission Guideline, Science and Ecosystem Support Division, Athens, GA; SESDGUID-106-RO, December 17, 2010.
- USEPA, 2010. Communicating Environmental Data to Property Owners and Tenants (Standard Operating Procedure, Version #1), Interim Final, October 2010.



TABLES

TABLE 1
Target Compounds and Reporting Limits
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
AMEC Project 6252-12-0006

Analyte	CAS Number	PQL	MDL	Comparison Value (basis)
1,1-Dichloroethene	75-35-4	1	0.56	7 (MCL)
cis-1,2-Dichloroethene	156-59-2	1	0.19	70 (MCL)
trans-1,2-Dichloroethene	156-60-5	1	0.49	100 (MCL)
Tetrachloroethene	127-18-4	1	0.46	5 (MCL)
1,1,1-Trichloroethane	71-55-6	1	0.48	200 (MCL)
Trichloroethene	79-01-6	1	0.47	5 (MCL)
Vinyl chloride	75-01-4	1	0.62	2 (MCL)

Notes:

CAS - Chemical Abstracts Service

PQL - Practical Quantitative Limit

MDL - Method Detection Limit

MCL - Maximum Contaminant Level

Concentrations are in micrograms per liter (µg/L)

Prepared By: SEK 8/22/12

Checked By: LRD 8/22/12

TABLE 2
Laboratory Electronic Data Deliverable Format
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
AMEC Project 6252-12-0006

Equis "EZEDD01" Field Name	data type	Required for "EDD"	Description	"TED" Table	"TED" Column
project_code	1 Text20	X	This field contains the internal project_code used by TED to identify a unique site. This will be provided to the lab on a per project basis.	Location	Site_id
sample_name	2 Text30	X	This field contains the sample number as written in the Analysis Request and Chain of Custody (AR/COC) form sent to the laboratory with the field samples for analysis. This is a unique number assigned to each sample by sampling personnel. For laboratory samples enter "LAB QC".	sample_collection	field_sample_id
sys_sample_code	3 Text20				
sample_date	4 Date	X	mm/dd/yyyy. Date sample was collected in the field. Date information must be identical with the date from the AR/COC form. Leave blank for lab samples. Year may be entered as yyyy.	sample_collection	field_sample_date
sample_time	5 Time				
analysis_location	6 Text2				
lab_name_code	7 Text10	X	Laboratory that performed the analysis.	sample_analysis	lab_id
lab_sample_id	8 Text20	X	Unique sample ID internally assigned by the laboratory.	sample_analysis	lab_sample_id
sample_type_code	9 Text10	X	Specifies sample type. For field samples, enter FS (regular environmental sample), otherwise, use values listed in the LOV. For example, normal field samples must be distinguished from laboratory method blank samples, etc.	sample_collection	qc_code
Lab_Del_Group	10 Text20	X	Tracking code used by the laboratory. Commonly called Sample Delivery Group (SDG).	sample_analysis	lab_sample_delivery_group
Lab_Batch_Number	11 Text20		Tracking number used by the laboratory to identify a group of samples analyzed in the same batch. This field, in conjunction with laboratory blank ID, is used to link the relationship between field samples and laboratory blank and other QC samples.		
lab_anl_method_name	12 Text35	X	Test method used in the analysis of the analyte.	sample_analysis	analysis_method

TABLE 2
Laboratory Electronic Data Deliverable Format
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
AMEC Project 6252-12-0006

Equis "EZEDD01" Field Name	data type	Required for "EDD"	Description	"TED" Table	"TED" Column
cas_rn	13 Text15	X	Unique analyte identifier. Use assigned CAS number when one is identified for an analyte. Tentatively Identified Compounds (TICs) and a number of other analytes are not assigned a standard CAS number. The laboratory is required to assign a UNIQUE identifier for all chemical_names.	sample_analysis_results	casno
chemical_name	14 Text60	X	Name of analyte or parameter analyzed.		
result_value	15 Text20	X	Must only be a numeric value. It is stored as a string of characters so that significant digits can be retained. Must be identical with values presented in the hard copy. Analytical result is reported left justified. Reported as the reporting_detection_limit for non-detects.	sample_analysis_results	lab_result
lab_qualifiers	16 Text7	X	Qualifier flags assigned by the laboratory.	sample_analysis_results	lab_qualifier
result_unit	17 Text15	X	This format assumes that the result value and detect limit have the same units.	sample_analysis_results	result_uom
result_type_code	18 Text10	X	Parameter list type. Valid Values = Target analytes (TCL, TAL or TRG); Surrogates (SUR); and TICs	sample_analysis_results	result_type
detect_flag	19 Text2	X	Enter "Y" for detected analytes or "N" for non-detected analytes.	sample_analysis_results	report_hit_flag
reporting_detection_limit	20 Text20	X	Must only be a numeric value. Use the value of the Reported Detection Limit (RDL), Practical Quantitation Limit (PQL), or Contract Required Quantitation Limit. Value is stored as a string to retain significant figures. Unit of measure must be identical with result_unit value.	sample_analysis_results	detection_limit
dilution_factor	21 Text6	X	Must be a numeric entry. The factor by which the sample was diluted as part of the preparation process. If no dilution was done, enter the value 1. Value is stored as a string to retain significant figures.	sample_analysis	dilution_factor
sample_matrix_code	22 Text10	X	Code which distinguishes between different type of sample matrix. For example, soil samples must be distinguished from groundwater samples, etc. Valid codes for HESE are "L" (liquid).	sample_collection	matrix

TABLE 2
Laboratory Electronic Data Deliverable Format
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
AMEC Project 6252-12-0006

Equis "EZEDD01" Field Name	data type	Required for "EDD"	Description	"TED" Table	"TED" Column
total_or_dissolved (or fraction)	23 Text1	X	Must be "T" for total metal concentration, "D" for dissolved or filtered metal concentration, or "N" for organic (or other) parameters for which neither "total" nor "dissolved" is applicable. Also, HESE requires "C" for TCLP and "S" for SPLP fractions.	sample_analysis	fraction
basis	24 Text10				
analysis_date	25 Date	X	mm/dd/yyyy. Date sample was analyzed.	sample_analysis	analysis_date
analysis_time	26 Time				
method_detection_limit	27 Text20				
lab_prep_method_name	28 Text35		Description of sample preparation or extraction method.	sample_analysis	prep_method_name
prep_date	29 Date	X	mm/dd/yyyy. This field is used to determine whether holding times for field samples have been exceeded.	sample_analysis	extraction_date
prep_time	30 Time				
test_batch_id	31 Text20	X	Default is 1 for primary results. Other valid values are 2, 3, 4, 5, and RE. Primary use is for reanalyses and dilutions where more than one result may be reported.	sample_analysis	run_id
result_error_delta	32 Text20				
TIC_retention_time	33 Text8				
qc_level	34 Text10		Laboratory QC level associated with the analysis	sample_analysis	qc_level
result_comment	35 Text255		Any comments related to the analysis.	sample_analysis_results	comments
sample_quantitation_limit (may be REQUIRED FIELD for certain projects)	36 Text20		Must only be a numeric value. Use the value of the Sample Quantitation Limit (SQL). Value is stored as a string to retain significant figures. Unit of measure must be identical with result_unit value.	sample_analysis_results	TBD

Note: All "X" marked fields are minimum data required to load data to "TED".

TABLE 3
Sample Container, Preservation, and Holding Time Requirements
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
AMEC Project 6252-12-0006

Analysis	EPA Analysis Method	Container	Sample Volume	Preservative	Hold Time
VOCs	8260B	VOA with Teflon [®] -lined septum	3 x 40 mL	HCl to pH<2; 4°C	14 days

Notes:

VOCs - volatile organic compounds

HCl - hydrochloric acid

mL - milliliter

Prepared By: SEK 2/20/12

Checked By: CSR 2/21/12

TABLE 4
Project Quality Control Limits
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
AMEC Project 6252-12-0006

Parameter	QC Test	%R	RPD
VOC	Field Duplicate		30
	Surrogate	70-130	
	LCS/LCSD	70-130	30
	MS/MSD	70-130	30

Notes:

LCS - laboratory control sample

LCSD - laboratory control sample duplicate

MS - matrix spike

MSD - matrix spike duplicate

%R - percent recovery

RPD relative percent difference

Prepared By: CSR 8/22/12

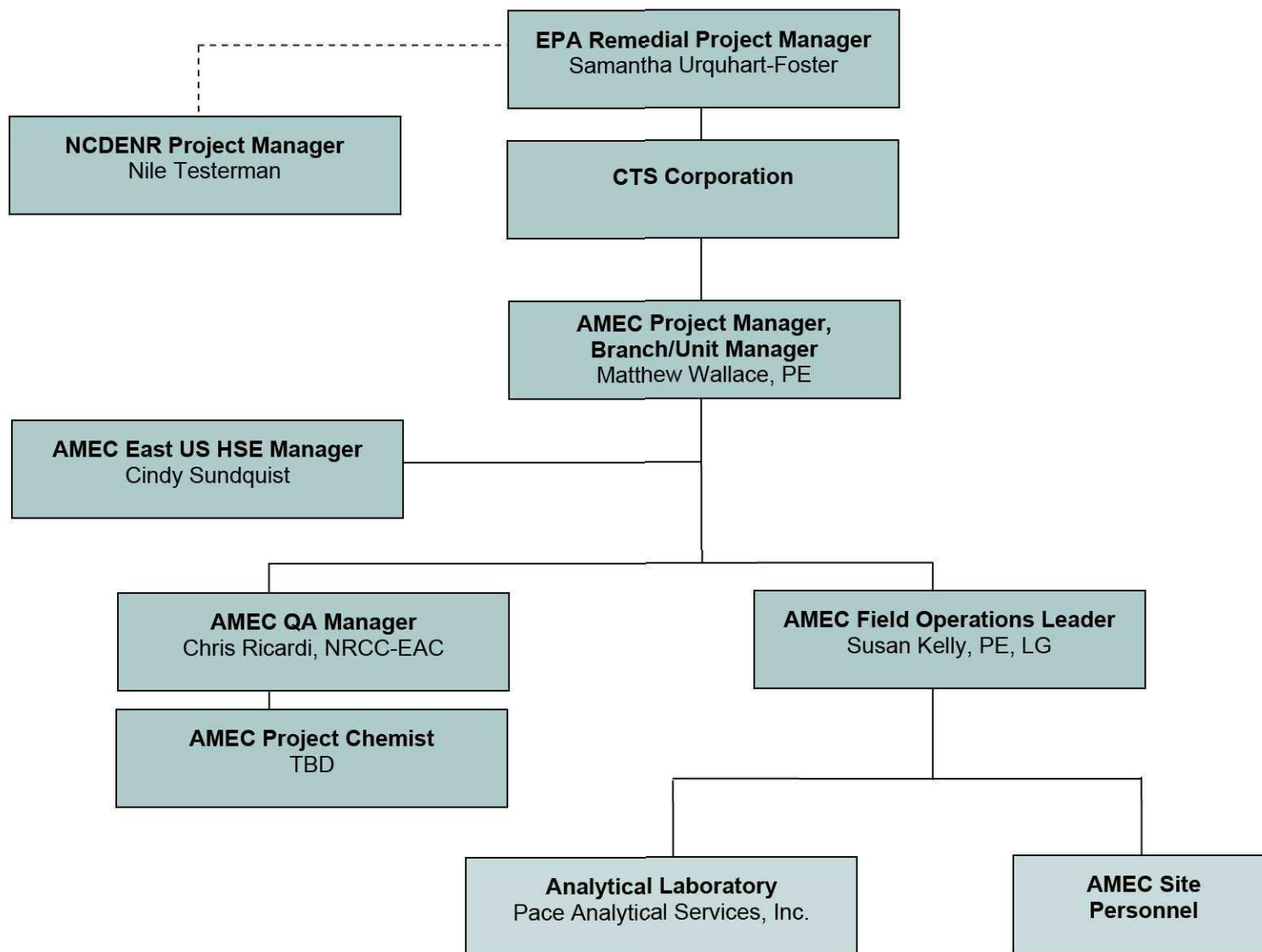
Checked By: SEK 8/22/12



APPENDIX A

ORGANIZATION CHART


Organization Chart





APPENDIX B

PACE ANALYTICAL SERVICES, INC. QUALITY ASSURANCE MANUAL

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	Document No.: Quality Assurance Manual rev.14.0	Issuing Authorities: Pace Corporate Quality Office Pace Carolinas Quality Office

QUALITY ASSURANCE MANUAL

Quality Assurance/Quality Control Policies and Procedures

Pace Analytical Services – Carolinas

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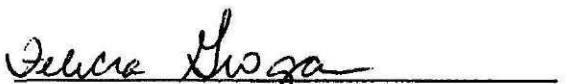
04.08.2011
Date

LOCAL APPROVAL

Effective Date is the date of the last signature.



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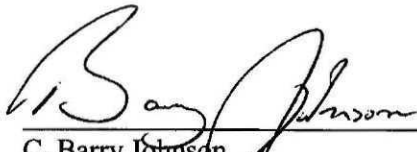
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4/13/11
Date

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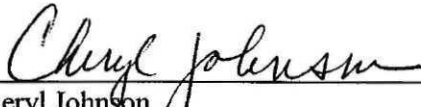
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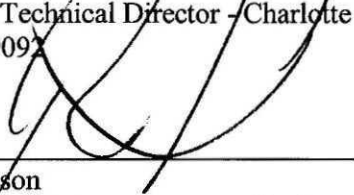
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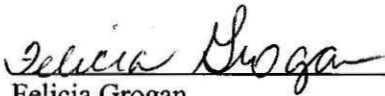
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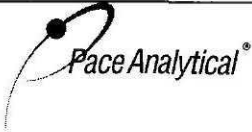

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1.0. INTRODUCTION AND ORGANIZATIONAL STRUCTURE

“Working together to protect our environment and improve our health”

Pace Analytical Services Inc. - Mission Statement

1.1. Introduction to PASI

Pace Analytical Services, Inc. (PASI) is a privately held, full-service analytical testing firm operating a nationwide system of laboratories. PASI offers extensive services beyond standard analytical testing, including: bioassay for aquatic toxicity, air toxics, industrial hygiene testing, explosives, dioxins and coplanar PCB's by high resolution mass spectroscopy, radiochemical analyses, product testing, pharmaceutical testing, field services and mobile laboratory capabilities. PASI has implemented a consistent Quality System in each of its laboratories and service centers. In addition, the company utilizes an advanced data management system that is highly efficient and allows for flexible data reporting. Together, these systems ensure data reliability and superior on-time performance. This document defines the Quality System and QA/QC protocols.

Our goal is to combine our expertise in laboratory operations with customized solutions to meet the specific needs of our customers.

1.2. Statement of Purpose


To meet the business needs of our customers for high quality, cost-effective analytical measurements and services.

1.3. Quality Policy Statement and Goals of the Quality System

PASI management is committed to maintaining the highest possible standard of service for our customers by following a documented quality system. The overall objective of this quality system is to provide reliable data of known quality through adherence to rigorous quality assurance policies and quality control procedures as documented in this Quality Assurance Manual.

All personnel within the PASI network are required to be familiar with all facets of the quality system relevant to their position and implement these policies and procedures in their daily work. This daily focus on quality is applied with initial project planning, continued through all field and laboratory activities, and is ultimately included in the final report generation.

PASI management demonstrates its commitment to quality by providing the resources, including facilities, equipment, and personnel to ensure the adherence to these documented policies and procedures and to promote the continuous improvement of the quality system. All PASI personnel must comply with all current applicable state, federal, and industry standards, such as the NELAC, TNI, NVLAP, and ISO 17025 standards, and are required to perform all tests in accordance with stated methods and customer requirements.

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1.4. Core Values

- **Integrity-** Pace personnel are required to abide by the PASI Code of Ethics and all Pace employees must go through Data Integrity/Ethics training upon initial orientation and as an annual refresher.
- **Value Employees-** Pace management views employees as our most important asset and communicates to them the relevance and importance of their activities within their job functions and how they contribute to the achievement of the objectives of the quality management system.
- **Know Our Customers-** Pace makes every effort to know our customers and address their sampling and analytical needs. More information on this item can be found in section 2.0.
- **Honor Commitments-** Pace labs focus on making solid commitments with regards to quality, capacity, and agreed upon turnaround time to our customers.
- **Flexible Response To Demand-** Pace labs are equipped with both the material and personnel resources to enable them to be responsive to the demands of customers when situations or projects need change.
- **Pursue Opportunities-** Pace is committed to pursuing opportunities for the growth of the company by constantly exploring markets and areas where we can expand.
- **Continuously Improve-** Pace has committed much time and effort into establishing a continuous improvement program where company personnel meet on a regular basis to share ideas in cost reduction, production improvement and standardization in order to develop best practices. This information, as well as company financial and production metrics, are tracked, evaluated, and shared with each Pace facility.


1.5. Code of Ethics

PASI's fundamental ethical principles are as follows:

- Each PASI employee is responsible for the propriety and consequences of his or her actions;
- Each PASI employee must conduct all aspects of Company business in an ethical and strictly legal manner, and must obey the laws of the United States and of all localities, states and nations where PASI does business or seeks to do business;
- Each PASI employee must reflect the highest standards of honesty, integrity and fairness on behalf of the Company with customers, suppliers, the public, and one another.
- Each PASI employee must recognize and understand that our daily activities in environmental laboratories affect public health as well as the environment and that environmental laboratory analysts are a critical part of the system society depends upon to improve and guard our natural resources:

Strict adherence by each PASI employee to this Code of Ethics and to the Standards of Conduct is essential to the continued vitality of PASI and to continue the pursuit of our common mission to protect our environment and improve our health.

Failure to comply with the Code of Ethics and Standards of Conduct will result in disciplinary action up to and including termination and referral for civil or criminal prosecution where appropriate. An employee will be notified of an infraction and given an opportunity to explain, as prescribed under current disciplinary procedures.

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1.6. Standards of Conduct

1.6.1. Data Integrity

The accuracy and integrity of the analytical results and its supporting documentation produced at PASI are the cornerstones of the company. Lack of data integrity is an assault on our most basic values putting PASI and its employees at grave financial and legal risk and will not be tolerated. Therefore, employees are to accurately prepare and maintain all technical records, scientific notebooks, calculations, and databases. Employees are prohibited from making false entries or misrepresentations of data for any reason.

Managerial staff must make every effort to ensure that personnel are free from any undue pressures that may affect the quality or integrity of their work including commercial, financial, over-scheduling, and working condition pressures.

1.6.2. Confidentiality

PASI employees must not use or disclose confidential or proprietary information except when in connection with their duties at PASI. This is effective over the course of employment and for an additional period of two years thereafter.


Confidential or proprietary information, belonging to either PASI and/or its customers, includes but is not limited to test results, trade secrets, research and development matters, procedures, methods, processes and standards, company-specific techniques and equipment, marketing and customer information, inventions, materials composition, etc.

1.6.3. Conflict of Interest

PASI employees must avoid situations that might involve a conflict of interest or could appear questionable to others. The employee must be careful in two general areas:

- Participation in activities that conflict or appear to conflict with the employees' PASI responsibilities.
- Offering or accepting anything that might influence the recipient or cause another person to believe that the recipient may be influenced to behave or in a different manner than he would normally. This includes bribes, gifts, kickbacks, or illegal payments.

Employees are not to engage in outside business or economic activity relating to a sale or purchase by the Company. Other problematic activities include service on the Board of Directors of a competing or supplier company, significant ownership in a competing or supplier company, employment for a competing or supplier company, or participation in any outside business during the employee's work hours.

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1.6.4. Compliance

All employees are required to read, understand, and comply with the various components of the standards listed in this document. As confirmation that they understand their responsibility, each employee is required to sign an acknowledgment form annually that then becomes part of the employee's permanent record. Employees will be held accountable for complying with the Quality Systems as summarized in the Quality Assurance Manual.

1.7. Laboratory Organization

The PASI Corporate Office centralizes company-wide accounting, business development, financial management, human resources development, information systems, marketing, quality, safety, and training activities. PASI's Director of Quality is responsible for assisting the development, implementation and monitoring of quality programs for the company. See Attachment IIB for the Corporate Organizational structure.


Each laboratory within the system operates with local management, but all share common systems and receive support from the Corporate Office.

A General Manager (GM) supervises each regional laboratory. Some operations may have an Assistant General Manager (AGM) in situations where the General Manager is responsible for multiple laboratory facilities and is not necessarily in the facility on a regular basis. Quality Managers (QM) at each laboratory report directly to their General Manager or Assistant General Manager and will also receive guidance and direction from the Director of Quality.

The General Manager bears the responsibility for the laboratory operations and serves as the final, local authority in all matters. In the absence of the General Manager or Assistant General Manager, the Quality Manager serves as the next in command. He or she assumes the responsibilities of the GM until the GM is available to resume the duties of their position. In the absence of the GM and QM, management responsibility of the laboratory is passed to the Technical Director – provided such a position is identified – and then to the most senior department manager until the return of the GM or QM. The most senior department manager in charge may include the Client Services Manager or the Administrative Business Manager at the discretion of the General Manager.

A Technical Director who is absent for a period of time exceeding 15 consecutive calendar days shall designate another full-time staff member meeting the qualifications of the technical director to temporarily perform this function. The laboratory General Manager or Quality Manager has the authority to make this designation in the event the existing Technical Director is unable to do so. If this absence exceeds 35 consecutive calendar days, the primary accrediting authority shall be notified in writing.

The Quality Manager has the responsibility and authority to ensure the Quality System is implemented and followed at all times. In circumstances where a laboratory is not meeting the established level of quality or following the policies set forth in this Quality Assurance Manual, the Quality Manager has the authority to halt laboratory operations should he or she deem such an action necessary. The QM will immediately communicate the halting of operations to the GM and keep him or her posted on the progress of corrective actions. In the event the GM and QM are not in agreement as to the need for the suspension, the Chief Operating Officer and Director of Quality will be called in to mediate the situation.

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Under the direction of the General Manager, the technical staff of the laboratory is generally organized into the following functional groups:

- Organic Sample Preparation
- Wet Chemistry Analysis
- Metals Analysis
- Volatiles Analysis
- Semi-volatiles Analysis
- Radiochemical Analysis
- Microbiology

Appropriate support groups are present in each laboratory. The actual organizational structure for PASI – Carolinas is listed in Attachment IIA. In the event of a change in General Manager, Quality Manager, or any Technical Director, the laboratory will notify its accrediting authorities and revise the organizational chart in the Quality Assurance Manual (QAM) within 30 days. For changes in Department Managers or Supervisors or other laboratory personnel, no notifications will be sent to the laboratory's accrediting agencies; changes to the organizational chart will be updated during or prior to the annual review process. Changes or additions in these key personnel will also be noted by additional signatures on the Quality Manual, as applicable. In any case, the QAM will remain in effect until the next scheduled revision.

1.8. Laboratory Job Descriptions


1.8.1. Senior General Manager

- Oversees all functions of all the operations within their designated region;
- Oversees the development of local General Managers within their designated region;
- Oversees and authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Oversees the preparation of budgets and staffing plans for all operations within their designated region;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.2. General Manager (local laboratory)

- Oversees all functions of the operations;
- Authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Prepares budgets and staffing plans;
- Monitors the Quality Systems of the laboratory and advises the Quality Manager accordingly;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.3. Assistant General Manager / Operations Manager

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- In the absence of the GM, performs all duties as listed above for the General Manager;
- Oversees the daily production and quality activities of all departments;
- Manages all departments and works with staff to ensure department objectives are met;
- Works with all departments to ensure capacity and customer expectations are accurately understood and met;
- Works with General Manager to prepare appropriate budget and staffing plans for all departments;
- Responsible for prioritizing personnel and production activities within all departments;
- Performs formal and informal performance reviews of departmental staff.

1.8.4. Quality Manager


- Oversees the laboratory Quality Systems while functioning independently from laboratory operations. Reports directly to the General Manager;
- Monitors Quality Assurance policies and Quality Control procedures to ensure that the laboratory achieves established standards of quality;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS);
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.5. Technical Director

- Monitors the standards of performance in quality assurance and quality control data;
- Monitors the validity of analyses performed and data generated;
- Reviews tenders, contracts and QAPPs to ensure the laboratory can meet the data quality objectives for any given project;
- Serves as the general manager of the laboratory in the absence of the GM, AGM and QM;
- Provides technical guidance in the review, development, and validation of new methodologies.

1.8.6. Administrative Business Manager

- Responsible for financial and administrative management for the entire facility;

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- Provides input relative to tactical and strategic planning activities;
- Organizes financial information so that the facility is run as a fiscally responsible business;
- Works with staff to confirm that appropriate processes are put in place to track revenues and expenses;
- Provide ongoing financial information to the General Manager and the management team so they can better manage their business;
- Utilizes historical information and trends to accurately forecast future financial positions;
- Works with management to ensure that key measurements are put in place to be utilized for trend analysis—this will include personnel and supply expenses, and key revenue and expense ratios;
- Works with General Manager to develop accurate budget and track on an ongoing basis;
- Works with entire management team to submit complete and justified capital budget requests and to balance requests across departments;
- Works with project management team and administrative support staff to ensure timely and accurate invoicing.

1.8.7. Client Services Manager

- Oversees all the day to day activities of the Client Services Department which includes Project Management and, possibly, Sample Control;
- Responsible for staffing and all personnel management related issues for Client Services;
- Serves as the primary senior consultant to customers on all project related issues such as set up, initiation, execution and closure;
- Performs or is capable of performing all duties listed for that of Project Manager.

1.8.8. Project Manager

- Coordinates daily activities including taking orders, reporting data and analytical results;
- Serves as the primary technical and administrative liaison between customers and PASI;
- Communicates with operations staff to update and set project priorities;
- Provides results to customers in the requested format (verbal, hardcopy, electronic, etc.);
- Works with customers, laboratory staff, and other appropriate PASI staff to develop project statements of work or resolve problems of data quality;
- Responsible for solicitation of work requests, assisting with proposal preparation and project initiation with customers and maintain customer records;
- Mediation of project schedules and scope of work through communication with internal resources and management;
- Responsible for preparing routine and non-routine quotations, reports and technical papers;
- Interfaces between customers and management personnel to achieve customer satisfaction;
- Manages large-scale complex projects;
- Supervises less experienced project managers and provide guidance on management of complex projects;
- Arranges bottle orders and shipment of sample kits to customers;
- Verifies login information relative to project requirements and field sample Chains-of-Custody.

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1.8.9. Project Coordinator

- Responsible for preparation of project specifications and provides technical/project support;
- Coordinates project needs with other department sections and assists with proposal preparation;
- Prepares routine proposals and invoicing;
- Responsible for scanning, copying, assembling and binding final reports;
- Other duties include filing, maintaining forms, process outgoing mail, maintaining training database and data entry.

1.8.10. Department Manager/Supervisor


- Oversees the day-to-day production and quality activities of their assigned department;
- Ensures that quality assurance and quality control criteria of analytical methods and projects are satisfied;
- Assesses data quality and takes corrective action when necessary;
- Approves and releases technical and data management reports;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.11. Group Supervisor/Leader

- Trains analysts in laboratory operations and analytical procedures;
- Organizes and schedules analyses with consideration for sample holding times;
- Implements data verification procedures by assigning data verification duties to appropriate personnel;
- Evaluates instrument performance and supervises instrument calibration and preventive maintenance programs;
- Reports non-compliance situations to laboratory management including the Quality Manager.

1.8.12. Laboratory Analyst

- Performs detailed preparation and analysis of samples according to published methods and laboratory procedures;
- Processes and evaluates raw data obtained from preparation and analysis steps;
- Generates final results from raw data, performing primary review against method criteria;
- Monitors quality control data associated with analysis and preparation. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks;
- Reports data in LIMS, authorizing for release pending secondary approval;
- Conducts routine and non-routine maintenance of equipment as required;
- Performs or is capable of performing all duties associated with that of Laboratory Technician.

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1.8.13. Laboratory Technician

- Prepares standards and reagents according to published methods or in house procedures;
- Performs preparation and analytical steps for basic laboratory methods;
- Works under the direction of a Laboratory Analyst on complex methodologies;
- Assists Laboratory Analysts on preparation, analytical or data reduction steps for complex methodologies;
- Monitors quality control data as required or directed. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks.

1.8.14. Field Technician


- Prepares and samples according to published methods, PASI Quality Assurance Manual and/or customer directed sampling objectives;
- Capable of the collection of representative environmental or process related air samples;
- Use computer software to compile, organize, create tables, create graphics and write test reports;
- Reviews project documentation for completeness, method compliance and contract fulfillment;
- Train less experienced environmental technicians and provide guidance on sampling and analysis;
- Responsible for project initiation and contact follow-up;
- Develop sampling plans and prepare test plan documents.

1.8.15. Sample Management Personnel

- Signs for incoming samples and verifies the data entered on the Chain of custody forms;
- Enters the sample information into the Laboratory Information Management System (LIMS) for tracking and reporting;
- Stages samples according to EPA requirements;
- Assists Project Managers and Coordinators in filling bottle orders and sample shipments.

1.8.16. Systems Administrator or Systems Manager

- Assists with the creation and maintenance of electronic data deliverables (EDDs);
- Coordinates the installation and use of all hardware, software and operating systems;
- Performs troubleshooting on all aforementioned systems;
- Trains new and existing users on systems and system upgrades;
- Maintains all system security passwords;
- Maintains the electronic backups of all computer systems.

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1.8.17. Safety/Chemical Hygiene Officer

- Maintains the laboratory Chemical Hygiene Plan;
- Plans and implements safety policies and procedures;
- Maintains safety records;
- Organizes and/or performs safety training;
- Performs safety inspections and provides corrective/preventative actions;
- Assists personnel with safety issues.

1.8.18. Program Director/Hazardous Waste Coordinator (or otherwise named)

- Evaluates waste streams and helps to select appropriate waste transportation and disposal companies;
- Maintains complete records of waste disposal including waste manifests and state reports;
- Assists in training personnel on waste-related issues such as waste handling and storage, waste container labeling, proper satellite accumulation, secondary containment, etc.;
- Conducts a weekly inspection of the waste storage areas of the laboratory.

1.9. Training and Orientation


Training for Pace employees is managed through a web-based Learning Management System. After a new employee has been instructed in matters of human resources, they are given instructional materials for the LMS and a password for access.

A new hire training checklist is provided to the new employee that lists training items for the employee to work through either independently on LMS or with their supervisor or trainer. The training items that can be completed independently include:

- Reading through applicable Standard Operating Procedures;
- Reviewing the Quality Manual and Chemical Hygiene Plan;
- Core training modules such as quality control indicators, basic laboratory skills, etc.;
- Quality Systems training including traceability of measurements, method calibration, calibration verification, accuracy, precision and uncertainty of measurements, corrective actions, documentation, and root cause analysis;
- Data Integrity/Ethics training.

The new employee's Department Supervisor provides the employee with a basic understanding of the role of the laboratory within the structure of PASI and the basic elements of that individual's position. Supervised training uses the following techniques:

- Hands-on training
- Training checklists/worksheets
- Lectures and training sessions
- Method-specific training
- Conferences and seminars

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- Short courses
- Specialized training by instrument manufacturers
- Proficiency testing programs.
- On-line courses

Group Supervisors/Leaders are responsible for providing documentation of training and proficiency for each employee under their supervision. The employee's training file indicates what procedures an analyst or a technician is capable of performing, either independently or with supervision. The files also include documentation of continuing capability, which are fully detailed in Section 3.4. Training documentation files for each person are maintained by the Quality Office either in hardcopy format or within the LMS.


All procedures and training records are maintained and available for review during laboratory audits. These procedures are reviewed/updated periodically by laboratory management. Additional information can be found in SOP S-ALL-Q-020 *Training Procedures* or its equivalent revision or replacement.

1.10. Data Integrity System

The data integrity system at PASI provides assurances to management that a highly ethical approach is being applied to all planning, training and implementation of methods. Data integrity is crucial to the success of our company and Pace Analytical is committed to creating and maintaining a culture of quality throughout the organization. To accomplish this goal, PASI has implemented a data integrity system that encompasses the following four requirements:

1. A data integrity training program: standardized training is given to each new employee and a yearly refresher is presented to all employees. Key topics addressed by this training include:
 - a. Need for honesty and transparency in analytical reporting
 - b. Process for reporting data integrity issues
 - c. Specific examples of unethical behavior and improper practices
 - d. Documentation of non-conforming data that is still useful to the data user
 - e. Consequences and punishments for unethical behavior
 - f. Examples of monitoring devices used by management to review data and systems
2. Signed data integrity documentation for all employees: this includes a written quiz following the Ethics training session and written agreement to abide by the Code of Ethics and Standards of Conduct explained in the employee manual.
3. In-depth, periodic monitoring of data integrity including peer data review and validation, internal raw data audits, proficiency testing studies, etc.
4. Documentation of any review or investigation into possible data integrity infractions. This documentation, including any disciplinary actions involved, corrective actions taken, and notifications to customers must be available for review for laboratory assessors and must be retained for a minimum of five years.

PASI management makes every effort to ensure that personnel are free from any undue pressures that affect the quality of their work including commercial, financial, over scheduling, and working condition pressures.

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Corporate management also provides all PASI facilities a mechanism for confidential reporting of data integrity issues that ensures confidentiality and a receptive environment in which all employees are comfortable discussing items of ethical concern. The anonymous message line is monitored by the Corporate Director of Quality who will ensure that all concerns are evaluated and, where necessary, brought to the attention of executive management and investigated. **The message line voice mail box number is available in the Pace Employee Handbook.**

1.11. Laboratory Safety

It is the policy of PASI to make safety and health an integral part of daily operations and to ensure that all employees are provided with safe working conditions, personal protective equipment, and requisite training to do their work without injury. Each employee is responsible for his/her own safety as well as those working in the immediate area by complying with established company rules and procedures. These rules and procedures as well as a more detailed description of the employees' responsibilities are contained in the corporate Safety Manual and Chemical Hygiene Plan.


1.12. Security and Confidentiality

Security is maintained by controlled access to laboratory buildings. Exterior doors to laboratory buildings remain either locked or continuously monitored by PASI staff. Keyless door lock combinations and computer access codes/logins are changed every six months or sooner as needed. Posted signs direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors, including PASI staff from other facilities, must sign the Visitor's Logbook maintained by the receptionist. A staff member will accompany them during the duration of their stay on the premises unless the GM, QM, or TD specify otherwise. In this instance, the staff member will escort the visitor back to the reception area at the end of his/her visit where he/she signs out. The last staff member to leave their department for the day should ensure that all outside access points to that area are secure.


Additional security is provided where necessary, e.g., specific secure areas for sample, data, and customer report storage, as requested by customers or cases where national security is of concern. These areas are lockable within the facilities, or are securely offsite. Access is limited to specific individuals or their designees. Security of sample storage areas is the responsibility of the Sample Custodian. Security of samples and data during analysis and data reduction is the responsibility of Group Supervisors. Security of customer report archives is the responsibility of the Client Services Manager. These secure areas are locked whenever these individuals or their designees are not present in the facility.

Access to designated laboratory sample storage locations is limited to authorized personnel only. Provisions for lock and key access are provided. No samples are to be removed without proper authorization. If requested by customer or contract, samples are not to be removed from secure storage areas without filling out an associated internal chain of custody.

Standard business practices of confidentiality are applied to all documents and information regarding customer analyses. Specific protocols for handling confidential documents are described in PASI SOPs. Additional protocols for sample identification by internal laboratory identification numbers only are implemented as required under contract specific Quality Assurance Project Plans (QAPPs).

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All information pertaining to a particular customer, including national security concerns will remain confidential. Data will be released to outside agencies only with written authorization from the customer or where federal or state law requires the company to do so.

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2.0. SAMPLE CUSTODY

2.1. Sampling Support

Each individual PASI laboratory provides shipping containers, properly preserved sample containers, custody documents, and field quality control samples to support field-sampling events. Guidelines for sample container types, preservatives, and holding times for a variety of methods are listed in Attachment VIII. Note that all analyses listed are not necessarily performed at all PASI laboratories and there may be additional laboratory analyses performed that are not included in these tables. PASI - Carolinas may provide pick-up and delivery services to their customers when needed.

2.2. Field Services

Pace Analytical has a large Field Services Division which is based in their Minneapolis facility as well as limited field service capabilities in some of our other facilities. Field Services provides comprehensive nationwide service offerings including:


- Stack Testing
- Ambient Air
- CEM Certification Testing
- Air Quality Monitoring
- Onsite Analytical Services- FTIR and GC
- Real-time Process Diagnostic/Optimization Testing
- Wastewater, Groundwater and Drinking Water Monitoring
- Storm Water and Surface Water Monitoring
- Soil and Waste Sampling
- Mobile Laboratory Services

Field Services operates under the PASI Corporate Quality System, with applicable and necessary provisions to address the activities, methods, and goals specific to Field Services. All procedures and methods used by Field Services are documented in Standard Operating Procedures and Procedure Manuals.

2.3. Project Initiation

Prior to accepting new work, the laboratory reviews its performance capability. The laboratory confirms that sufficient personnel, equipment capacity, analytical method capability, etc., are available to complete the required work. Customer needs, certification requirements, and data quality objectives are defined and the appropriate sampling and analysis plan is developed to meet the project requirements by project managers or sales representatives. Members of the management staff review current instrument capacity, personnel availability and training, analytical procedures capability, and projected sample load. Management then informs the sales and client services personnel whether or not the laboratory can accept the new project via written correspondence, email, and/or daily operations meetings.

The laboratory maintains records of all such reviews, including discussions with customers. Routine analytical project documentation of quotes, notes, dates, initials, and/or recordings is maintained in a

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project folder by project management. Conditions for new and more complex contracts are determined by the General Managers and sales representatives. Quality Management is consulted on technical requirements and operations staff provides input on volume capacities. Evidence of these reviews is maintained in the form of awarded Request for Proposals (RFPs), signed quotes or contracts, and a Customer Relationship Management (CRM) database. If a review identifies a potential mismatch between customer requirements and laboratory capabilities and/or capacities, Pace will specify its level of commitment by listing these exceptions to the requirements within the RFP, quote or contract.

Additional information regarding specific procedures for reviewing new work requests can be found in SOP S-ALL-C-006 *Review of Analytical Requests* or its equivalent revision or replacement.

2.4. Chain of Custody


A chain of custody (COC) provides the legal documentation of samples from time of collection to completion of analysis. PASI has implemented Standard Operating Procedures to ensure that sample custody traceability and responsibility objectives are achieved for every project.

Field personnel or client representatives must complete a chain of custody for all samples that are received by the laboratory. The importance of completeness of COCs is stressed to the samplers and is critical to efficient sample receipt and to insure the requested methods are used to analyze the correct samples.

If sample shipments are not accompanied by the correct documentation, the Sample Receiving department notifies a Project Manager. The Project Manager then obtains the correct documentation/information from the customer in order for analysis of samples to proceed.

The sampler is responsible for providing the following information on the chain of custody form:

- Customer project name
- Project location or number
- Field sample number/identification
- Date and time sampled
- Sample matrix
- Preservative
- Requested analyses
- Sampler signature
- Relinquishing signature
- Date and time relinquished
- Sampler remarks as needed
- Custody Seal Number if present
- Regulatory Program Designation
- The state where the samples were collected to ensure all applicable state requirements are met
- Turnaround time requested
- Purchase order number

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The COC is filled out completely and legibly with indelible ink. Errors are corrected by drawing a single line through the initial entry and initialing and dating the change. All transfers of samples are recorded on the chain of custody in the “relinquished” and “received by” sections. All information except signatures is printed.

Additional information can be found in SOP S-CAR-C-001 *Sample Management* or its equivalent revision or replacement.

2.5. Sample Acceptance Policy


In accordance with regulatory guidelines, PASI complies with the following sample acceptance policy for all samples received.

If the samples do not meet the sample receipt acceptance criteria outlined below, the laboratory is required to document all non-compliances, contact the customer, and either reject the samples or fully document any decisions to proceed with analyses of samples which do not meet the criteria. Any results reported from samples not meeting these criteria are appropriately qualified on the final report.

All samples must:

- Have unique customer identification that are clearly marked on durable waterproof labels affixed to the sample containers that match the chain of custody.
- Have clear documentation on the chain of custody related to the location of the sampling site with the time and date of sample collection.
- Have the sampler’s name and signature.
- Have all requested analyses clearly designated on the COC.
- Have clear documentation of any special analytical or data reporting requirements.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be correctly preserved unless the method allows for laboratory preservation.
- Be received within holding time. Any samples with hold times that are exceeded will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges - not frozen but $\leq 6^{\circ}\text{C}$ ^(See Note 1), unless program requirements or customer contractual obligations mandate otherwise ^(see Note 2). The cooler temperature is recorded directly on the COC and the SCUR. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

Note 1: Temperature will be read and recorded based on the precision of the measuring device. For example, temperatures obtained from a thermometer graduated to 0.1°C will be read and recorded to

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$\pm 0.1^{\circ}\text{C}$. Measurements obtained from a thermometer graduate to 0.5°C will be read to $\pm 0.5^{\circ}\text{C}$. Measurements read at the specified precision are not to be rounded down to meet the $\leq 6^{\circ}\text{C}$ limit

Note 2: Some microbiology methods allow sample receipt temperatures of up to 10°C . Consult the specific method for microbiology samples received above 6°C prior to initiating corrective action for out of temperature preservation conditions.

Upon sample receipt, the following items are also checked and recorded:

- Presence of custody seals or tapes on the shipping containers
- Sample condition: Intact, broken/leaking, bubbles in VOA samples
- Sample holding time
- Sample pH when required
- Appropriate containers

Samples for drinking water analysis that are improperly preserved, or are received past holding time, are rejected at the time of receipt, with the exception of VOA samples that are tested for pH at the time of analysis.

Additional information can be found in SOP S-CAR-C-001 *Sample Management* or its equivalent revision or replacement.


2.6. Sample Log-in

After sample inspection, all sample information on the chain of custody is entered into the Laboratory Information Management System.

This permanent record documents receipt of all sample containers including:

- Customer name and contact
- Customer number
- Pace Analytical project number
- Pace Analytical Project Manager
- Sample descriptions
- Due dates
- List of analyses requested
- Date and time of laboratory receipt
- Field ID code
- Date and time of collection
- Any comments resulting from inspection for sample rejection

All samples received are logged into the LIMS within one working day of receipt. Sample login may be delayed due to customer clarification of analysis needed, corrective actions for sample receipt non-conformance, or other unusual circumstances. If the time collected for any sample is unspecified and Pace is unable to obtain this information from the customer, the laboratory will use 08:00 as the time sampled. All hold times will be based on this sampling time and qualified accordingly if exceeded.

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The Laboratory Information Management System (EPIC Pro) automatically generates a unique identification number for each sample created in the system. The LIMS sample number follows the general convention of BBXXXXXXYY. The BB represents the laboratory identification within Pace's laboratory network. The five digit "X" number represents the project number. The three digit "Y" number represents the sample number. The project number is a sequential number that is assigned as a new project is created. The sample number corresponds to the number of samples submitted by the client. In addition to the unique sample ID, there is a sample container ID that consists of the sample number, the container type (ex. BP1U), and bottle 1 of Y where Y represents the total number of containers of that particular type. Together the sample LIMS number and sample container ID create a unique barcode encryption that can be linked to the sample analysis requested by the client. This unique identification number is placed on the sample container as a durable label and becomes the link between the laboratory's sample management system and the customer's field identification; it will be a permanent reference number for all future interactions.

Current region codes are noted below. More may be added without updating this document.

10 = Minnesota	35 = Florida
92 = Asheville and Charlotte	20 = Gulf Coast
60 = Kansas	30 = Pittsburgh
50 = Indianapolis	40 = Green Bay
3038 = Pittsburgh Radiological	17 = Pace Life Sciences
25 = Seattle	65 = Schenectady (NEA)
51 = Columbus	

Sample labels are printed from the LIMS and affixed to each sample container.

Samples with hold times that are near expiration date/time may be sent directly to the laboratory for analysis at the discretion of the Project Manager and/or General Manager.

Additional information can be found in SOP S-CAR-C-001 *Sample Management* or its equivalent revision or replacement.


2.7. Sample Storage

2.7.1. Storage Conditions

Samples are stored away from all standards, reagents, or other potential sources of contamination. Samples are stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Storage blanks, consisting of two 40mL aliquots of reagent water, are stored with volatile samples and are used to measure cross-contamination acquired during storage. If applicable, laboratories must have documented procedures and criteria for evaluating storage blanks, appropriate to the types of samples being stored.

2.7.2. Temperature Monitoring

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Samples are taken to the appropriate storage location immediately after sample receipt and check-in procedures are completed. All sample storage areas are located in limited access areas and are monitored to ensure sample integrity.

The temperature of each refrigerated storage area is maintained at $\leq 6^{\circ}\text{C}$ unless state or program requirements differ. The temperature of each freezer storage area is maintained at $< -10^{\circ}\text{C}$ unless state or program requirements differ. The temperature of each storage area is checked and documented each day of use (each calendar day). If the temperature falls outside the acceptable limits, the following corrective actions are taken and appropriately documented:

- The temperature is rechecked after two hours to verify temperature exceedance. Corrective action is initiated if necessary.
- The Quality Manager and/or laboratory management are notified if the problem persists.
- The samples are relocated to a proper environment if the temperature cannot be maintained after corrective actions are implemented.
- The affected customers are notified.
- Documentation is provided on analytical report.

2.7.3. Hazardous Materials

Samples determined to be hazardous by analysis are labeled and stored in the hazardous waste location in the sample disposal area until removed by a qualified vendor.

Pure product or potentially heavily contaminated samples must be tagged as "hazardous" or "lab pack" and stored separately from other samples.

2.7.4. Foreign/Quarantined Soils


Depending on the soil disposal practices of the laboratory, foreign soils and soils from USDA regulated areas are segregated. The USDA requires these samples to be incinerated or sterilized by an approved treatment procedure. Additional information regarding USDA regulations and sample handling can be found in applicable local laboratory SOPs.

Additional information on sample storage can be found in SOP S-CAR-C-001 *Sample Management* or its equivalent revision or replacement and in SOP S-CHR-S-002 *Waste Handling and Management* (Charlotte laboratory) or SOP S-ASV-S-002 *Waste Handling and Management* (Asheville and Eden laboratories).

2.8. Sample Protection

PASI laboratory facilities are operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times.

Samples are removed from storage areas by designated personnel and returned to the storage areas, if necessary, immediately after the required sample quantity has been taken.

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Upon customer request, additional and more rigorous chain of custody protocols for samples and data can be implemented. For example, some projects may require complete documentation of sample custody within the secure laboratory.

Additional information can be found in SOP S-CAR-C-001 *Sample Management* or its equivalent revision or replacement.

2.9. Subcontracting Analytical Services

Every effort is made to perform all analyses for PASI customers within the laboratory that receives the samples. When subcontracting to a laboratory other than the receiving laboratory, whether inside or outside the PASI network, becomes necessary, a preliminary verbal communication with that laboratory is undertaken. Customers are notified in writing of the subcontracting laboratory's intention to subcontract any portion of the testing to another laboratory. Work performed under specific protocols may involve special considerations.

Prior to subcontracting samples to a laboratory outside Pace Analytical, the potential sub-contract laboratory will be pre-qualified by verifying that the subcontractor meets the following criteria:


- All certifications required for the proposed subcontract are in effect,
- Sufficient professional liability and other required insurance coverage is in effect, and
- Is not involved in legal action by any federal, state, or local government agency for data integrity issues and has not been convicted in such investigation at any time during the past 5 years.

The contact and preliminary arrangements are made between the PASI Project Manager and the appropriate subcontract laboratory personnel. The specific terms of the subcontract laboratory agreement include:

- Method of analysis
- Number and type of samples expected
- Project specific QA/QC requirements
- Deliverables required
- Laboratory certification requirement
- Price per analysis
- Turn-around time requirements

Chain of custody forms are generated for samples requiring subcontracting to other laboratories. Sample receiving personnel re-package the samples for shipment, create a transfer chain of custody form and record the following information:

- Pace Analytical Laboratory Number
- Matrix
- Requested analysis
- Special instructions regarding turnaround, required detection or reporting limits, or any unusual information known about the samples or analytical procedure.
- Signature in "Relinquished By"

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All subcontracted sample data reports are sent to the PASI Project Manager. Pace will provide a copy of the subcontractor's report to the client when requested.

Any Pace Analytical work sent to other labs within the PASI network is handled as subcontracted work and all final reports are labeled clearly with the name of the laboratory performing the work. Any non-NELAC work is clearly identified. PASI will not be responsible for analytical data if the subcontract laboratory was designated by the customer.

Additional information can be found in SOP S-CAR-ALL-C-003 *Subcontracting Samples* or its equivalent revision or replacement.


2.10. Sample Retention and Disposal

Samples, extracts, digestates, and leachates must be retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

Unused portions of samples are retained by each laboratory based on program or customer requirements for sample retention and storage. The sample retention time is a minimum of 45 days from receipt of the samples. Samples requiring storage beyond this time due to special requests or contractual obligations will not be stored under temperature controlled conditions unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer. If it is not feasible to return samples, or the customer requires PASI to dispose of excess samples, proper arrangements will be made for disposal by an approved contractor.

Additional information can be found in SOP S-CHR-S-002 *Waste Handling and Management* (Charlotte laboratory) or SOP S-ASV-S-002 *Waste Handling and Management* (Asheville and Eden laboratories) and S-CAR-C-001 *Sample Management* or their equivalent revisions or replacements.

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3.0. ANALYTICAL CAPABILITIES

3.1. Analytical Method Sources

PASI laboratories are capable of analyzing a full range of environmental samples from a variety of matrices, including air, surface water, wastewater, groundwater, soil, sediment, biota, and other waste products. The latest valid editions of methodologies are applied from regulatory and professional sources including EPA, ASTM, USGS, NIOSH, Standard Methods, and State Agencies. Section 11 is a representative listing of general analytical protocol references. PASI discloses in writing to its customers and regulatory agencies any instances in which modified methods are being used in the analysis of samples.

In the event of a customer-specific need, instrumentation constraint or regulatory requirement, PASI laboratories reserve the right to use valid versions of methods that may not be the most recent edition available.

3.2. Analytical Method Documentation

The primary form of PASI laboratory documentation of analytical methods is the Standard Operating Procedure (SOP). SOPs contain pertinent information as to what steps are required by an analyst to successfully perform a procedure. The required contents for the SOPs are specified in the company-wide SOP for Preparation of SOPs (S-ALL-Q-001).


The SOPs may be supplemented by other training materials that further detail how methods are specifically performed. *This training material will undergo periodic, documented review along with the other Quality System documentation.*

3.3. Analytical Method Validation

In some situations, PASI develops and validates methodologies that may be more applicable to a specific problem or objective. When non-standard methods are required for specific projects or analytes of interest, or when the laboratory develops or modifies a method, the laboratory validates the method prior to applying it to customer samples. Method validity is established by meeting criteria for precision and accuracy as established by the data quality objectives specified by the end user of the data. The laboratory records the validation procedure, the results obtained and a statement as to the usability of the method. The minimum requirements for method validation include determination of the limit of detection and limit of quantitation, evaluation of precision and bias, and evaluation of selectivity of each analyte of interest.

3.4. Demonstration of Capability (DOC)

Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method, or at any time that a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and standard deviation of each analyte, taken from 4 replicates of a quality control standard is calculated and compared to method criteria (if available) or established laboratory criteria for evaluation of acceptance. Each laboratory maintains copies of all demonstrations of capability, including those

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that fail acceptance criteria and corresponding raw data for future reference and must document the acceptance criteria prior to the analysis of the DOC. Demonstrations of capability are verified on an annual basis.

For Continuing Demonstrations of Capability, the laboratories may use Performance Testing (PT) samples in lieu of the 4-replicate approach listed above. For methods or procedures that do not lend themselves to the “4-replicate” approach, the demonstration of capability requirements will be specified in Section 13 – Method Performance of the applicable SOP.


Additional information can be found in SOP S-ALL-Q-020 *Training Procedures* or its equivalent revision or replacement.

3.5. Regulatory and Method Compliance

PASI understands that expectations of our customers commonly include the assumption that laboratory data will satisfy specific regulatory requirements. Therefore PASI attempts to ascertain, prior to beginning a project, what applicable regulatory jurisdiction, agency, or protocols apply to that project. This information is also required on the chain of custody submitted with samples.

PASI makes every effort to detect regulatory or project plan inconsistencies, based upon information from the customer, and communicate them immediately to the customer in order to aid in the decision making process. PASI will not be liable if the customer chooses not to follow PASI recommendations.

It is PASI policy to disclose in a forthright manner any detected noncompliance affecting the usability of data produced by our laboratories. The laboratory will notify customers within 30 days of fully characterizing the nature of the nonconformance, the scope of the nonconformance and the impact it may have on data usability.

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4.0. QUALITY CONTROL PROCEDURES

Quality control data is analyzed and where they are found to be outside pre-defined criteria, planned action is taken to correct the problem in order to prevent incorrect results from being reported. Quality control samples are to be processed in the same manner as client samples.

4.1. Method Blank

A method blank is used to evaluate contamination in the preparation/analysis system and is processed through all preparation and analytical steps with its associated samples.

A method blank is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, a method blank is processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

The method blank consists of a matrix similar to the associated samples that is known to be free of analytes of interest. Laboratories will characterize a representative matrix as "clean" if the matrix contains contaminants at less than ½ the laboratory's reporting limit.

Method blanks are not applicable for certain analyses, such as pH, conductivity, flash point and temperature.

Each method blank is evaluated for contamination. The source of any contamination is investigated and documented corrective action is taken when the concentration of any target analyte is detected above the reporting limit and is greater than 1/10 of the amount of that analyte found in any associated sample. Corrective actions include the re-preparation and re-analysis of all the samples (where possible) along with the full set of required quality control samples. Data qualifiers must be applied to any result reported that is associated with a contaminated method blank.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.


4.2. Laboratory Control Sample

The Laboratory Control Sample (LCS) is used to evaluate the performance of the entire analytical system including preparation and analysis.

An LCS is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, an LCS will be processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

The LCS consists of a matrix similar to the associated samples that is known to be free of the analytes of interest that is then spiked with known concentrations of target analytes.

The LCS contains **all** analytes specified by a specific method or by the customer or regulatory agency (which may include full list of target compounds, with certain exceptions. These exceptions may include analyzing only specific Aroclors when PCB analysis is requested or not spiking with all

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EPA Appendix IX compounds when a full Appendix IX list of compounds is requested). In the absence of specified components, the laboratory will spike with the following compounds:


- For multi-peak analytes (e.g. PCBs, technical chlordane, toxaphene), a representative standard will be processed.
- For methods with long lists of analytes, a representative number of target analytes may be chosen. The following criteria is used to determine the number of LCS compounds used:
 - For methods with 1-10 target compounds, the laboratory will spike with all compounds
 - For methods with 11-20 target compounds, the laboratory will spike with at least 10 compounds or 80%, whichever is greater
 - For methods with greater than 20 compounds, the laboratory will spike with at least 16 compounds.

The LCS is evaluated against the method default or laboratory-derived acceptance criteria. For those methods that require laboratory-derived limits, method default control limits may be used until the laboratory has a minimum of 20, but preferably greater than 30, data points from which to derive internal acceptance criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Any associated sample containing an 'out-of-control' compound must either be re-analyzed with a successful LCS or reported with the appropriate data qualifier. When the acceptance criteria for the LCS are exceeded high, and there are associated samples that are non-detects, then those non-detects can be reported with data qualifiers, or when the acceptance criteria are exceeded low, those associated sample results may be reported if they exceed the maximum regulatory limit/decision level with data qualifiers.

For LCSs containing a large number of analytes, it is statistically likely that a few recoveries will be outside of control limits. This does not necessarily mean that the system is out of control, and therefore no corrective action would be necessary (except for proper documentation). NELAC has allowed for a minimum number of marginal exceedances, defined as recoveries that are beyond the LCS control limits (3X the standard deviation) but less than the marginal exceedance limits (4X the standard deviation). The number of allowable exceedances depends on the number of compounds in the LCS. If more analyte recoveries exceed the LCS control limits than is allowed (see below) or if any one analyte exceeds the marginal exceedance limits, then the LCS is considered non-compliant and corrective actions are necessary. The number of allowable exceedances is as follows:

- >90 analytes in the LCS- 5 analytes
- 71-90 analytes in the LCS- 4 analytes
- 51-70 analytes in the LCS- 3 analytes
- 31-50 analytes in the LCS- 2 analytes
- 11-30 analytes in the LCS- 1 analyte
- <11 analytes in the LCS- no analytes allowed out)

A matrix spike (MS) can be used in place of a non-compliant LCS in a batch as long as the MS passes the LCS acceptance criteria (this is a NELAC allowance). When this happens, full documentation must be made available to the data user. If this is not allowed by a customer or regulatory body, the associated samples must be rerun with a compliant LCS (if possible) or reported with appropriate data qualifiers.

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Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

4.3. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

A matrix spike (MS) is used to determine the effect of the sample matrix on compound recovery for a particular method. The information from these spikes is sample or matrix specific and is not used to determine the acceptance of an entire batch unless the MS is actually used as the LCS.

A **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** set is processed at a frequency specified in a particular method or as determined by a specific customer request. This frequency will be specified in the applicable method SOP or customer QAPP. In the absence of such requirements, an MS/MSD set is routinely analyzed once per every 20 samples per matrix per method.

The MS and MSD consist of the sample matrix that is then spiked with known concentrations of target analytes. Laboratory personnel spike customer samples that are specifically designated as MS/MSD samples or, when no designated samples are present in a batch, randomly select samples to spike that have adequate sample volume or weight. Spiked samples are prepared and analyzed in the same manner as the original samples and are selected from different customers if possible.

The MS and MSD contain all analytes specified by a specific method or by the customer or regulatory agency. In the absence of specified components, the laboratory will spike with the same number of compounds as previously discussed in the LCS section.

The MS and MSD are evaluated against the method or laboratory derived criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. The spike recoveries give the data user a better understanding of the final results based on their site specific information.


A matrix spike and sample duplicate will be performed instead of a matrix spike and matrix spike duplicate when specified by the customer or method.

In order to meet the requirement of EPA method 1664A for performing a matrix spike on 5% of all waste streams, Pace Analytical Services – Carolinas field unit will collect enough sample volume in order that a matrix spike may be performed. Refer to SOP S-CHR-F-001 *Waste Water Sampling* or its equivalent revision or replacement.

The Laboratory's Information Management System, EPIC Pro, randomly selects the sample used for spiking.

Recommended minimum requirements for QC samples that should be met in order to satisfy criteria for acceptable data quality have been used to determine a process to meet Data Quality Objectives:

To document the effect of matrix on precision, accuracy, and detection limit a matrix spike/matrix spike duplicate or matrix spike and sample duplicate pair will be included in each batch of up to 20 samples of the same matrix processed together. A group of samples of the same matrix which behave similarly with respect to the sampling and testing procedures analyzed or extracted under the

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same method, conditions, instrumentation, personnel, and standards can be considered to be processed together. A group of samples should be processed together within a reasonable timeframe of 24 hours to 21 days.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

4.4. Surrogates

Surrogates are compounds that reflect the chemistry of target analytes and are typically added to samples for organic analyses to monitor the effect of the sample matrix on compound recovery.

Surrogates are added to each customer sample (for organics), method blank, LCS, and MS prior to extraction or analysis. The surrogates are evaluated against the method or laboratory derived acceptance criteria or against project-specific acceptance criteria specified by the client, if applicable. Any surrogate compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Samples with surrogate failures are typically re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error. An exception to this would be samples that have high surrogate values but no reportable hits for target compounds. These samples would be reported, with a qualifier, because the implied high bias would not affect the final results. For methods with multiple surrogates, documentation regarding acceptance and associated compounds will be found in the individual method SOPs.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

4.5. Sample Duplicate

A sample duplicate is a second portion of sample that is prepared and analyzed in the laboratory along with the first portion. It is used to measure the precision associated with preparation and analysis. A sample duplicate is processed at a frequency specified by the particular method or as determined by a specific customer.


The sample and duplicate are evaluated against the method or laboratory derived criteria for relative percent difference (RPD). Any duplicate that is outside of these limits is considered to be 'out of control' and must be qualified appropriately.

EPIC Pro randomly selects the sample used for duplication.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

4.6. Internal Standards

Internal Standards are method-specific analytes added to every standard, method blank, laboratory control sample, matrix spike, matrix spike duplicate, and sample at a known concentration, prior to

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analysis for the purpose of adjusting the response factor used in quantifying target analytes. At a minimum, the laboratory will follow method specific guidelines for the treatment of internal standard recoveries as they are related to the reporting of data.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

4.7. Field Blanks

Field blanks are blanks prepared at the sampling site in order to monitor for contamination that may be present in the environment where samples are collected. These field quality control samples are often referenced as field blanks, rinsate blanks, or equipment blanks. The laboratory analyzes these field blanks as normal samples and informs the customer if there are any target compounds detected above the reporting limits.

4.8. Trip Blanks

Trip blanks are blanks that originate from the laboratory as part of the sampling event and are used to monitor for contamination of samples during transport. These blanks accompany the empty sample containers to the field and then accompany the collected samples back to the laboratory. These blanks are routinely analyzed for volatile methods where ambient background contamination is likely to occur.

4.9. Limit of Detection (LOD)


PASI laboratories are required to use a documented procedure to determine a limit of detection for each analyte of concern in each matrix reported. All sample processing steps of the preparation and analytical methods are included in this determination including any clean ups. For any test that does not have a valid LOD, sample results below the limit of quantitation (LOQ) cannot be reported.

The LOD is initially established for the compounds of interest for each method in a clean matrix with no target analytes present and no interferences at a concentration that would impact the results. The LOD is then determined every time there is a change in the test method that affects how the test is performed or when there has been a change in the instrument that affects the sensitivity. If required by customer, method or accreditation body, the LOD will be re-established annually for all applicable methods.

Unless otherwise noted, the method used by PASI laboratories to determine LODs is based on the Method Detection Limit (MDL) procedure outlined in 40 CFR Part 136, Appendix B. Where required by regulatory program or customer, the above referenced procedure will be followed.

Where specifically stated in the published method, LODs or MDLs will be performed at the listed frequency.

The validity of the LOD must be shown by detection (a value above zero) of the analytes in a QC sample in each quality system matrix. The QC sample must contain the analyte at no more than 3X the LOD for a single analyte test and 4X the LOD for multiple analyte tests. This verification must be performed on each instrument used for sample analysis and reporting of data. The validity of the

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LOD must be verified as part of the LOD determination process. This verification must be done prior to the use of the LOD for sample analysis.

An LOD study is not required for any analyte for which spiking solutions or quality control samples are not available such as temperature.

The LOD, if required, shall be verified annually for each quality system matrix, technology and analyte. In lieu of performing full LOD (MDL) studies annually, the laboratory can verify the LOD (MDL) on an annual basis, providing this verification is fully documented and does not contradict other customer or program requirements that the laboratory must follow. The requirements of this verification are:

- The spike concentration of the verification must be no more than 3X times the LOD for single analyte tests and 4X the LOD for multiple analyte tests.
- The laboratory must verify the LOD on each instrument used for the reporting of sample data.
- The laboratory must be able to identify all target analytes in the verification standard (distinguishable from noise).

Additional information can be found in SOP S-ALL-Q-004 *Method Detection Limit Studies* or its equivalent revision or replacement.

4.10. Limit of Quantitation (LOQ)

A limit of quantitation (LOQ) for every analyte of concern must be determined. For PASI laboratories, this LOQ is referred to as the RL, or Reporting Limit. This RL is based on the lowest calibration standard concentration that is used in each initial calibration. Results below this level are not allowed to be reported without qualification since the results would not be substantiated by a calibration standard. For methods with a determined LOD, results can be reported out below the LOQ but above the LOD if they are properly qualified (e.g. J flag).


The LOQ must be higher than the LOD.

To verify the LOQ, the laboratory will prepare a sample in the same matrix used for the LCS. The sample will be spiked with target analytes at the concentration(s) equivalent to or less than the RL(s). This sample must undergo the routine sample preparation procedure including any routine sample cleanup steps. The sample is then analyzed and the recovery of each target analyte determined. The recovery for each target analyte must meet the laboratories current control limits for an LCS.

Additional information can be found in SOP S-ALL-Q-004 *Method Detection Limit Studies* or its equivalent revision or replacement.

4.11. Estimate of Analytical Uncertainty

PASI laboratories can provide an estimation of uncertainty for results generated by the laboratory. The estimate quantifies the error associated with any given result at a 95% confidence interval. This estimate does not include bias that may be associated with sampling. The laboratory has a procedure

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in place for making this estimation. In the absence of a regulatory or customer-specific procedure, PASI laboratories base this estimation on the recovery data obtained from the Laboratory Control Spikes. The uncertainty is a function of the standard deviation of the recoveries multiplied by the appropriate Student's t Factor at 95% confidence.

The measurement of uncertainty is provided only on request by the customer, as required by specification or regulation and when the result is used to determine conformance within a specification limit.

4.12. Proficiency Testing (PT) Studies

PASI laboratories participate in the NELAC defined proficiency testing program. PT samples are obtained from NIST approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing per matrix.

The laboratory initiates an investigation whenever PT results are deemed 'unacceptable' by the PT provider. All findings and corrective actions taken are reported to the Quality Manager. A corrective action plan is initiated and this report is sent to the appropriate state accreditation agencies for their review. Additional PTs will be analyzed and reported as needed for certification purposes.

PT samples are treated as typical customer samples, utilizing the same staff, methods, equipment, facilities, and frequency of analysis. PT samples are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

Comparison of analytical results with anyone participating in the same PT study is prohibited prior to the close of the study.

Additional information can be found in SOP S-ALL-Q-010 *PE/PT Program* or its equivalent revision or replacement.


4.13. Rounding and Significant Figures

In general, the PASI laboratories report data to no more than three significant digits. Therefore, all measurements made in the analytical process must reflect this level of precision. In the event that a parameter that contributes to the final result has less than three significant figures of precision, the final result must be reported with no more significant figures than that of the parameter in question. The rounding rules listed below are descriptive of the LIMS and not necessarily of any supporting program such as Excel.

4.13.1. Rounding

PASI-Carolinas follows the odd / even guidelines for rounding numbers:


- If the figure following the one to be retained is less than five, that figure is dropped and the retained ones are not changed (with three significant figures, 2.544 is rounded to 2.54).
- If the figure following the ones to be retained is greater than five, that figure is dropped and the last retained one is rounded up (with three significant figures, 2.546 is rounded to 2.55).

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- If the figure following the ones to be retained is five and if there are no figures other than zeros beyond that five, then the five is dropped and the last figure retained is unchanged if it is even and rounded up if it is odd (with three significant figures, 2.525 is rounded to 2.52 and 2.535 is rounded to 2.54).

4.13.2. Significant Digits

Unless specified by federal, state, or local requirements or on specific request by a customer, PASI-Carolinas reports all analytical results to 3 significant digits, regardless of the magnitude of the value reported.

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5.0. DOCUMENT MANAGEMENT AND CHANGE CONTROL

5.1. Document Management

Additional information can be found in SOP S-ALL-Q-002 *Document Management* or its equivalent revision or replacement. Information on Pace's policy for electronic signatures can also be found in this SOP.

Pace Analytical Services, Inc. has an established procedure for managing documents that are part of the quality system. The list of managed documents includes, but is not limited to, Standard Operating Procedures (both technical and non-technical), Quality Assurance Manuals, quality policy statements, training documents, work-processing documents, charts, posters, memoranda, notices, forms, software, and any other procedures, tables, plans, etc. that have a direct bearing on the quality system (including applicable data records and non-technical documents).

A master list of all managed documents is maintained at each facility identifying the current revision status and distribution of the controlled documents. This establishes that there are no invalid or obsolete documents in use in the facility. All documents are reviewed periodically and revised if necessary. Obsolete documents are systematically discarded or archived for audit or knowledge preservation purposes.


Each managed document is uniquely identified to include the date of issue, the revision identification, page numbers, the total number of pages and the issuing authorities. For complete information on document numbering, refer to SOP S-ALL-Q-003 *Document Numbering*.

SOPs, specifically, are available to all laboratory staff via the Learning Management System (LMS) which is a secure repository that is accessed through an internet portal. As a local alternative to the hard copy system of controlled documents, secured electronic copies of controlled documents may be maintained on the laboratory's local server. These document files must be read-only for all personnel except the Quality Department and system administrator. Other requirements for this system are as follows:

- Electronic documents must be readily accessible to all facility employees.
- Electronic documents must be locked from printing. All hardcopy SOPs must be obtained from the Quality Department.

5.1.1. Quality Assurance Manual (QAM)

The Quality Assurance Manual is the company-wide document that describes all aspects of the quality system for PASI. The base QAM template is distributed by the Corporate Quality Department to each of the regional Quality Managers. The regional management personnel modify the necessary and permissible sections of the base template and submit those modifications to the Corporate Director of Quality for review. Once approved and signed by both the CEO and the Director of Quality; the General Manager, Quality Manager, and any Technical Directors sign the Quality Assurance Manual. Each regional Quality Manager is then in charge of distribution to employees, external customers or regulatory agencies and maintaining a distribution list of controlled document copies. The Quality Assurance Manual

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template is reviewed on an annual basis by all of the PASI Quality Managers and revised accordingly by the Director of Quality.

5.1.2. Standard Operating Procedures (SOPs)

SOPs fall into two categories: company-wide documents and facility specific documents. Company-wide SOPs start with the prefix S-ALL- and local SOPs start with the individual facility prefix.

The purpose of the company-wide SOPs is to establish policies and procedure that are common and applicable to all PASI facilities. Company-wide SOPs are document-controlled by the corporate quality office and signed copies are distributed to all of the regional Quality Managers. The regional management personnel sign the company-wide SOPs. The regional Quality Manager is then in charge of distribution to employees, external customers, or regulatory agencies and maintaining a distribution list of controlled document copies.

Regional PASI facilities are responsible for developing facility-specific SOPs applicable to their respective facility. The regional facility develops these facility-specific SOPs based on the corporate-wide SOP template. This template is written to incorporate a set of minimum method requirements and PASI best practice requirements. The regional facilities may add to or modify the corporate-wide SOP template provided there are no contradictions to the minimum method or best practice requirements. Facility-specific SOPs are controlled by the regional Quality Manager according to the corporate document management policies.


SOPs are reviewed every two years at a minimum although a more frequent review may be required by some state or federal agencies or customers. A review of the document does not necessarily constitute issuing a new revision. Documentation of this review and any applicable revisions are made in the last section of each SOP. This provides a historical record of all revisions.

All copies of superseded SOPs are removed from general use and the original copy of each SOP is archived for audit or knowledge preservation purposes. This ensures that all PASI employees use the most current version of each SOP and provides the Quality Manager with a historical record of each SOP.

Additional information can be found in SOP S-ALL-Q-001 *Preparation of SOPs* or its equivalent revision or replacement.

5.2. Document Change Control


Changes to managed documents are reviewed and approved in the same manner as the original review. Any revision to a document requires the approval of the applicable signatories. After revisions are approved, a revision number is assigned and the previous version of the document is officially retired. Copies may be kept for audit or knowledge preservation purposes.

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All controlled copies of the previous document are replaced with controlled copies of the revised document and the superseded copies are destroyed or archived. All affected personnel are advised that there has been a revision and any necessary training is scheduled.

5.3. Management of Change

The process for documenting necessary changes within the laboratory network are not typically handled using the corrective or preventive action system as outlined in section 9.0. Management of Change is a proactive approach to dealing with change to minimize the potential negative impact of systematic change in the laboratory and to ensure that each change has a positive desired outcome. This process will primarily be used for the implementation of large scale projects and information system changes as a means to apply consistent systems or procedures within the laboratory network. The request for change is submitted by the initiator and subsequently assigned to an individual or team for development and planning. The final completion of the process culminates in final approval and verification that the procedure was effectively implemented.

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6.0. EQUIPMENT and Measurement TRACEABILITY

Each PASI facility is equipped with sufficient instrumentation and support equipment to perform the relevant analytical testing or field procedures performed by each facility. Support equipment includes chemical standards, thermometers, balances, disposable and mechanical pipettes, etc. This section details some of the procedures necessary to maintain traceability and to perform proper calibration of instrumentation and support equipment. See Attachment III for a list of equipment currently used at the PASI-Carolinas facilities.

6.1. Standards and Traceability

Each PASI facility retains all pertinent information for standards, reagents, and chemicals to assure traceability to a national standard. This includes documentation of purchase, receipt, preparation, and use.

Upon receipt, all purchased standard reference materials are recorded into a standard logbook or database and assigned a unique identification number. The entries include the facility's unique identification number, the chemical name, manufacturer name, manufacturer's identification numbers, receipt date, and expiration date. Vendor's certificates of analysis for all standards, reagents, or chemicals are retained for future reference.

Subsequent preparations of intermediate or working solutions are also documented in a standard logbook or database. These entries include the stock standard name and lot number, the manufacturer name, the solvents used for preparation, the solvent lot number and manufacturer, the preparation steps, preparation date, expiration dates, preparer's initials, and a unique PASI identification number. This number is used in any applicable sample preparation or analysis logbook so the standard can be traced back to the standard preparation record. This process ensures traceability back to the national standard.


All prepared standard or reagent containers include the PASI identification number, the standard or chemical name, the date of preparation, the date of expiration, the concentration with units, and the preparer's initials. This ensures traceability back to the standard preparation logbook.

For containers that are too small to accommodate labels that list all of the above information associated with a standard, the minimum required information will be PASI standard ID, concentration, and expiration date. This assures that no standard will be used past its assigned expiration date.

If a second source standard is required to verify an existing calibration or spiking standard, this standard should be obtained from a different manufacturer or from a different lot unless client specific QAPP requirements state otherwise.

Additional information concerning standards and reagent traceability can be found in the SOP S-ALL-Q-025 *Standard and Reagent Preparation and Traceability* or its equivalent revision or replacement.

6.2. General Analytical Instrument Calibration Procedures

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All support equipment and instrumentation are calibrated or checked before use to ensure proper functioning and verify that the laboratory's requirements are met. All calibrations are performed by, or under the supervision of, an experienced analyst at scheduled intervals against either certified standards traceable to recognized national standards or reference standards whose values have been statistically validated.

Calibration standards for each parameter are chosen to establish the linear range of the instrument and must bracket the concentrations of those parameters measured in the samples. The lowest calibration standard is the lowest concentration for which quantitative data may be reported. Data reported below this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in a narrative. The highest calibration standard is the highest concentration for which quantitative data may be reported. Data reported above this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in the narrative. Any specific method requirement for number and type of calibration standards supersedes the general requirement. Instrument and method specific calibration criteria are explained within the specific analytical standard operating procedures for each facility.

Instrumentation or support equipment that cannot be calibrated to specification or is otherwise defective is clearly labeled as out-of-service until it has been repaired and tested to demonstrate it meets the laboratory's specifications. All repair and maintenance activities including service calls are documented in the maintenance log. Equipment sent off-site for calibration testing is packed and transported to prevent breakage and is in accordance with the calibration laboratory's recommendations.


In the event that recalibration of a piece of test equipment indicates the equipment may have been malfunctioning during the course of sample analysis, an investigation is performed. The results of the investigation along with a summary of the information reviewed are documented and maintained by the quality manager. If the investigation indicates sample results have been impacted, the customer is notified within 30 days. This allows for sufficient investigation and review of documentation to determine the impact on the analytical results. Instrumentation found to be consistently out of calibration is either repaired and positively verified or taken out of service and replaced.

Raw data records are retained to document equipment performance. Sufficient raw data is retained to reconstruct the instrument calibration and explicitly connect the continuing calibration verification to the initial calibration.

6.2.1. General Organic Calibration Procedures

Calibration standards are prepared at a minimum of five concentrations for organic analyses. Results from all calibration standards analyzed must be included in constructing the calibration curve with the following exceptions:

- The lowest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The reporting limit must be adjusted to the lowest concentration included in the calibration curve.
- The highest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and

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standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The upper limit of quantitation must be adjusted to the highest concentration included in the calibration curve.

- Multiple points from either the high end or the low end of the calibration curve may be excluded as long as the remaining points are contiguous in nature and the minimum number of levels remains as established by method or standard operating procedure. The reporting limit or quantitation range, which is appropriate, must be adjusted accordingly.
- Results from a concentration level between the lowest and highest calibration levels can be excluded from the calibration curve for an acceptable cause with approval from the responsible department supervisor if the results for all analytes are excluded and the point is replaced by re-analysis. Re-analysis must occur within the same 12 hour tune time period for GC/MS methodologies and within 8 hours of the initial analysis for non-GC/MS methodologies. All samples analyzed prior to the re-analyzed calibration curve point must be re-analyzed after the calibration curve is completed.


Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Curves that do not meet the appropriate criteria require corrective action that may include re-running the initial calibration curve. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if that lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

The calibration curve is periodically verified by the analysis of a mid-level continuing calibration verification (CCV) standard during the course of sample analysis. Continuing calibration verification is performed at the beginning and end of each analytical batch except if an internal standard is used, then only one verification at the beginning of the batch is needed, whenever it is expected that the analytical system may be out of calibration, if the time period for calibration has expired, or for analytical systems that have specific calibration verification requirements. This verification standard must meet acceptance criteria in order for sample analysis to proceed.

In the event that the CCV does not meet the acceptance criteria, a second CCV may be injected as part of the diagnostic evaluation and corrective action investigation. If the second CCV is acceptable, the analytical sequence may be continued. If both CCVs fail, the analytical sequence is terminated and corrective action is initiated. Sample analysis cannot begin until after documented corrective action has been completed and two consecutive passing CCVs have been analyzed. If required by specific state, program, or customer specification, the instrument is re-calibrated after two consecutive CCV failures. All samples analyzed since the last compliant CCV are re-analyzed for methodologies utilizing external calibration.

When instruments are operating unattended, autosamplers may be programmed to inject consecutive CCVs as a preventative measure against CCV failure with no corrective action. In this case, both CCVs must be evaluated to determine potential impact to the results. A summary of the decision tree and necessary documentation are listed below:

- If both CCVs meet the acceptance criteria, the analytical sequence is allowed to continue without corrective action. The 12 hour clock begins with the injection of the second CCV.

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- If the first CCV does not meet the acceptance criteria and the second CCV is acceptable, the analytical sequence is continued and the results are reported.
- If the first CCV meets the acceptance criteria and the second CCV is out of control, the samples preceded by the out of control CCV must be re-analyzed in a compliant analytical sequence.
- If both CCVs are out of control, all samples since the last acceptable CCV must be re-analyzed in a compliant analytical sequence.

Some analytical methods require that samples be bracketed by passing CCVs analyzed both before and after the samples. This is specific to each method but, as a general rule, all external calibration methods require bracketing CCVs. Most internal standard calibrations do not require bracketing CCVs.

Some analytical methods require verification based on a time interval; some methods require a frequency based on an injection interval. The type and frequency of the calibration verifications is dependent on both the analytical method and possibly on the quality program associated with the samples. The type and frequency of calibration verification will be documented in the method specific SOP employed by each laboratory.

6.2.2. General Inorganic Calibration Procedures

The instrument is initially calibrated with standards at multiple concentrations to establish the linearity of the instrument's response. A calibration blank is also included. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. The number of calibration standards used depends on the specific method criteria or customer project requirements, although normally a minimum of three standards is used.


The ICP and ICP/MS can be standardized with a zero point and a single point calibration if:

- Prior to analysis, the zero point and the single point calibration are analyzed and a linear range has been established,
- Zero point and single point calibration standards are analyzed with each batch
- A standard corresponding to the LOQ is analyzed with the batch and meets the established acceptance criteria
- The linearity is verified at the frequency established by the method or manufacturer.

All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if the lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

During the course of analysis, the calibration curve is periodically verified by the analysis of calibration verification standards (CCV). A calibration verification standard is analyzed within each analytical batch at method/program specific intervals to verify that the initial calibration is still valid. The CCV is also analyzed at the end of the analytical batch.

A calibration blank is also run with each calibration verification standard to verify the cleanliness of the system. All reported results must be bracketed by acceptable CCVs. Instrument and method

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specific calibration acceptance criteria are explained within the specific analytical standard operating procedures for each facility.

Interference check standards are also analyzed per method requirements and must meet acceptance criteria for metals analyses.

6.3. Support Equipment Calibration Procedures

All support equipment is calibrated or verified at least annually using NIST traceable references over the entire range of use. The results of calibrations or verifications must be within the specifications required or the equipment will be removed from service until repaired. The laboratory maintains records to demonstrate the correction factors applied to working thermometers.

On each day the equipment is used, balances, ovens, refrigerators (those used to keep samples and standards at required temperatures), freezers, and water baths are checked in the expected use range with NIST traceable references in order to ensure the equipment meets laboratory specifications and these checks are documented appropriately.

6.3.1. Analytical Balances

Each analytical balance is calibrated or verified at least annually by a qualified service technician. The calibration of each balance is verified each day of use with weights traceable to NIST bracketing the range of use. Calibration weights are ASTM Class 1 or other class weights that have been calibrated against a NIST standard weight and are re-certified annually against a NIST traceable reference. Some accrediting agencies may require more frequent checks. If balances are calibrated by an external agency, verification of their weights must be provided. All information pertaining to balance maintenance and calibration is recorded in the individual balance logbook and/or is maintained on file in the Quality department.

6.3.2. Thermometers

Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are re-certified, at a minimum, every 3 years with equipment directly traceable to NIST.


Working thermometers are compared with the reference thermometers annually according to corporate metrology procedures. Each thermometer is individually numbered and assigned a correction factor based on the NIST reference source. In addition, working thermometers are visually inspected by laboratory personnel prior to use and temperatures are documented.

Laboratory thermometer inventory and calibration data are maintained in the Quality department.

6.3.3. pH/Electrometers

The meter is calibrated before use each day, using fresh buffer solutions.

6.3.4. Spectrophotometers

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During use, spectrophotometer performance is checked at established frequencies in analysis sequences against initial calibration verification (ICV) and continuing calibration verification (CCV) standards.

6.3.5. Mechanical Volumetric Dispensing Devices

Mechanical volumetric dispensing devices including bottle top dispensers, pipettes, and burettes, excluding Class A volumetric glassware, are checked for accuracy on a quarterly basis. The accuracy of glass microliter syringes is verified and documented prior to initial use.

Additional information regarding calibration and maintenance of laboratory support equipment can be found in SOP S-ALL-Q-013 *Support Equipment* or its equivalent revision or replacement.

6.4. Instrument/ Equipment Maintenance

The objectives of the Pace Analytical maintenance program are twofold: to establish a system of instrument care that maintains instrumentation and equipment at required levels of calibration and sensitivity, and to minimize loss of productivity due to repairs.


The Laboratory Operations Manager and department manager/supervisors are responsible for providing technical leadership to evaluate new equipment, solve equipment problems, and coordinate instrument repair and maintenance. Analysts have the primary responsibility to perform routine maintenance.

To minimize downtime and interruption of analytical work, preventative maintenance is routinely performed on each analytical instrument. Up-to-date instructions on the use and maintenance of equipment are available to staff in the department where the equipment is used.

Department manager/supervisors are responsible for maintaining an adequate inventory of spare parts required to minimize equipment downtime. This inventory includes parts and supplies that are subject to frequent failure, have limited lifetimes, or cannot be obtained in a timely manner should a failure occur.

All major equipment and instrumentation items are uniquely identified to allow for traceability. Equipment/instrumentation is, unless otherwise stated, identified as a system and not as individual pieces. The laboratory maintains equipment records that include the following:


- The name of the equipment and its software
- The manufacturer's name, type, and serial number
- Approximate date received and date placed into service
- Current location in the laboratory
- Condition when received (new, used, etc.)
- Copy of any manufacturer's manuals or instructions
- Dates and results of calibrations and next scheduled calibration (if known)
- Details of past maintenance activities, both routine and non-routine
- Details of any damage, modification or major repairs

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All instrument maintenance is documented in maintenance logbooks that are assigned to each particular instrument or system.

When maintenance is performed to repair an instrument problem, depending on the initial problem, demonstration of return to control may be satisfied by the successful analysis of a tune, reagent blank, or continuing calibration standard depending on the instrument problem. The maintenance log entry must include a summary of the results of that analysis and verification by the analyst that the instrument has been returned to an in-control status. In addition, each entry must include the initials of the analyst making the entry, the dates the maintenance actions were performed, and the date the entry was made in the maintenance logbook, if different from the date(s) of the maintenance.

Any equipment that has been subjected to overloading or mishandling, or that gives suspect results, or has been shown to be defective, is taken out of service and clearly identified. The equipment shall not be used to analyze customer samples until it has been repaired and shown to perform satisfactorily.

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7.0. CONTROL OF DATA

Analytical results processing, verification, and reporting are procedures employed that result in the delivery of defensible data. These processes include, but are not limited to, calculation of raw data into final concentration values, review of results for accuracy, evaluation of quality control criteria and assembly of technical reports for delivery to the data user.

All analytical data undergo a well-defined, well-documented multi-tier review process prior to being reported to the customer. This section describes procedures used by PASI for translating raw analytical data into accurate final sample reports as well as PASI data storage policies.

7.1. Analytical Results Processing

When analytical, field, or product testing data is generated, it is either recorded in a bound laboratory logbook (e.g. Run log or Instrument log) or copies of computer-generated printouts that are appropriately labeled and filed. These logbooks and other laboratory records are kept in accordance with each facility's Standard Operating Procedure for documentation storage and archival. If the laboratory chooses to minimize or eliminate its paper usage, these records can be kept on electronic media. In this case, the laboratory must ensure that there are sufficient redundant electronic copies so no data is lost due to unforeseen computer issues.

The primary analyst is responsible for initial data reduction and review. This includes confirming compliance with required methodology, verifying calculations, evaluating quality control data, noting non-conformances in logbooks or as footnotes or narratives, and uploading analytical results into the LIMS.


The primary analyst then compiles the initial data package for verification. This compilation must include sufficient documentation for data review. It may include standard calibrations, chromatograms, manual integration documentation, electronic printouts, chain of custody forms, and logbook copies.

Some agencies or customers require different levels of data reporting. For these special levels, the primary analyst may need to compile additional project information, such as initial calibration data or extensive spectral data, before the data package proceeds to the verification step.

7.2. Data Verification

Data verification is the process of examining data and accepting or rejecting it based on pre-defined criteria. This review step is designed to ensure that reported data are free from calculation and transcription errors, that quality control parameters are evaluated, and that any non-conformances are properly documented.

Analysts performing the analysis and subsequent data reduction have primary responsibility for quality of the data produced. The primary analyst initiates the data verification process by reviewing and accepting the data, provided QC criteria have been met for the samples being reported. Data review checklists, either hardcopy or electronic, are used to document the data review process. The primary analyst is responsible for the initial input of the data into the LIMS.

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The completed data package is then sent to a designated qualified reviewer (this cannot be the primary analyst). The following criteria have been established to qualify someone as a data reviewer. To perform secondary data reviewer, the reviewer must:

1. Have a current Demonstration of Capability (DOC) study on file and have an SOP acknowledgement form on file for the method/procedure being reviewed; or, ^{See Note}
2. Have a DOC on file for a similar method/technology (i.e. GC/MS) and have an SOP acknowledgment form on file for the method/procedure being reviewed; or, ^{See Note}
3. Supervise or manage a Department and have an SOP acknowledgment form on file for the method/procedure being reviewed; or,
4. Have significant background in the department/methods being reviewed through education or experience and have an SOP acknowledgment form on file for the method/procedure being reviewed.

Note: Secondary reviewer status must be approved personally by the Quality Manager or General Manager in the event that this person has no prior experience on the specific method or general technology.

This reviewer provides an independent technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. This assessment involves a quality control review for use of the proper methodology and detection limits, compliance to quality control protocol and criteria, presence and completeness of required deliverables, and accuracy of calculations and data quantitation. The reviewer also validates the data entered into the LIMS.

Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise initialing and dating the data (or designating the review of data electronically). The Operations or Project Manager examines the report for method appropriateness, detection limits and QC acceptability. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution.


Additional information regarding data review procedures can be found in SOP S-ALL-Q-037 **Data Review** or its equivalent revision or replacement.

An EPIC Pro Data Checker program assists the Project Manager in review and evaluation of project reports. The Data Checker will process validated data for a given project against a set of determined requirements and known chemistry relationships. Information on the use of Data Checker can be found in SOP S-ALL-Q-030 **Operation of Data Checker for EPIC Pro** or its equivalent revision or replacement.

7.3. Data Reporting

Data for each analytical fraction pertaining to a particular PASI project number are delivered to the Project Manager for assembly into the final report. All points mentioned during technical and QC reviews are included in a case narrative if there is potential for data to be impacted.


Final reports are prepared according to the level of reporting required by the customer and can be transmitted to the customer via hardcopy or electronic deliverable. A standard PASI final report consists of the following components:

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1. A title which designates the report as "Final Report", "Laboratory Results", "Certificate of Results", etc.
2. Name and address of laboratory (or subcontracted laboratories, if used).
3. Phone number and name of laboratory contact to where questions can be referred.
4. A unique identification number for the report. The pages of the report shall be numbered and a total number of pages shall be indicated.
5. Name and address of customer and name of project
6. Unique identification of samples analyzed as well as customer sample IDs.
7. Identification of any sample that did not meet acceptable sampling requirements of the relevant governing agency, such as improper sample containers, holding times missed, sample temperature, etc.
8. Date and time of collection of samples, date of sample receipt by the laboratory, dates of sample preparation and analysis, and times of sample preparation and analysis when the holding time for either is 72 hours or less.
9. Identification of the test methods used.
10. Identification of sampling procedures if sampling was conducted by the laboratory.
11. Deviations from, additions to, or exclusions from the test methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc., and can be shown as a case narrative or as defined footnotes to the analytical data.
12. Identification of whether calculations were performed on a dry or wet-weight basis.
13. Reporting limits used.
14. Final results or measurements, supported by appropriate chromatograms, charts, tables, spectra, etc.
15. A signature and title, electronic or otherwise, of person accepting responsibility for the content of the report.
16. Date report was issued.
17. A statement clarifying that the results of the report relate only to the samples tested or to the samples as they were received by the laboratory.
18. If necessary, a statement indicating that the report must not be reproduced except in full, without the written approval of the laboratory.
19. Identification of all test results provided by a subcontracted laboratory or other outside source.
20. Identification of results obtained outside of quantitation levels.

In addition to the requirements listed above, final reports shall also contain the following items when necessary for the interpretation of results:

21. Deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions.
22. Where relevant, a statement of compliance/non-compliance with requirements and/or specifications (e.g., the TNI standard).
23. Where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when the uncertainty affects compliance to a specification limit.
24. Where appropriate and needed, opinions and interpretations, which may include opinions on the compliance/non-compliance of the results with requirements, fulfillment of contractual requirements, recommendations on how to use the results, and guidance to be used for improvement.

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25. Additional information which may be required by specific methods, regulatory agencies, or customers.

Any changes made to a final report shall be designated as "Revised" or equivalent wording. The laboratory must keep sufficient archived records of all laboratory reports and revisions. For higher levels of data deliverables, a copy of all supporting raw data is sent to the customer along with a final report of results. When possible, the PASI facility will provide electronic data deliverables (EDD) as required by contracts or upon customer request.

Customer data that requires transmission by telephone, telex, facsimile or other electronic means *undergoes appropriate steps to preserve confidentiality.*

The following positions are the only approved signatories for PASI final reports:

- Senior General Manager
- General Manager
- Quality Manager
- Client Services Manager
- Project Manager
- Project Coordinator

7.4. Data Security


All data including electronic files, logbooks, extraction/digestion/distillation worksheets, calculations, project files and reports, and any other information used to produce the technical report are maintained secured and retrievable by the PASI facility.

7.5. Data Archiving

All records compiled by PASI are maintained legible and retrievable and stored secured in a suitable environment to prevent loss, damage, or deterioration by fire, flood, vermin, theft, and/or environmental deterioration. Records are retained for a minimum of five years unless superseded by federal, state, contractual, and/or accreditation requirements. These records may include, but are not limited to, customer data reports, calibration and maintenance of equipment, raw data from instrumentation, quality control documents, observations, calculations, and logbooks. These records are retained in order to provide for possible historical reconstruction including sampling, receipt, preparation, analysis, and personnel involved. NELAP-related records will be made readily available to accrediting authorities. Access to archived data is documented and controlled by the Quality Manager or a designated Data Archivist.

Records that are computer generated have either a hard copy or electronic write protected backup copy. Hardware and software necessary for the retrieval of electronic data is maintained with the applicable records. Archived electronic records are stored protected against electronic and/or magnetic sources.


In the event of a change in ownership, accountability or liability, reports of analyses performed pertaining to accreditation will be maintained by the acquiring entity for a minimum of five years. In

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the event of bankruptcy, laboratory reports and/or records will be transferred to the customer and/or the appropriate regulatory entity upon request.

7.6. Data Disposal

Data that has been archived for the facility's required storage time may be disposed of in a secure manner by shredding, returning to customer, or utilizing some other means that does not jeopardize data confidentiality. Records of data disposal will be archived for a minimum of five years unless superseded by federal, contractual, and/or accreditation requirements.

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8.0. Quality System Audits and Reviews

8.1. Internal Audits

8.1.1. Responsibilities

The Quality Manager is responsible for designing and/or conducting internal audits in accordance with a predetermined schedule and procedure. Since internal audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation. The Quality Manager evaluates audit observations and verifies the completion of corrective actions. In addition, a periodic corporate audit will be conducted. The corporate audits will focus on the effectiveness of the Quality System as outlined in this manual but may also include other quality programs applicable to an individual laboratory.

8.1.2. Scope and Frequency of Internal Audits


The complete internal audit process consists of the following four sections:

- Raw Data Review audits- conducted according to a schedule per local Quality Manager. A certain number of these data review audits are conducted per quarter to accomplish this yearly schedule.
- Quality System audits- considered the traditional internal audit function and includes analyst interviews to help determine whether practice matches method requirements and SOP language.
- Final Report reviews
- Corrective Action Effectiveness Follow-up

Internal systems audits are conducted yearly at a minimum. The scope of these audits includes evaluation of specific analytical departments or a specific quality related system as applied throughout the laboratory.

Examples of system-wide elements that can be audited include:

- Quality Systems documents, such as Standard Operating Procedures, training documents, Quality Assurance Manual, and all applicable addenda
- Data records and non-technical documents
- Personnel and training files.
- General laboratory safety protocols.
- Chemical handling practices, such as labeling of reagents, solutions, and standards as well as all associated documentation.
- Documentation concerning equipment and instrumentation, calibration/maintenance records, operating manuals.
- Sample receipt and management practices.
- Analytical documentation, including any discrepancies and corrective actions.
- General procedures for data security, review, documentation, reporting, and archiving.

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- Data integrity issues such as proper manual integrations.

When the operations of a specific department are evaluated, a number of additional functions are reviewed including:

- Detection limit studies
- Internal chain of custody documentation
- Documentation of standard preparations
- Quality Control limits and Control charts

Certain projects may require an internal audit to ensure laboratory conformance to site work plans, sampling and analysis plans, QAPPs, etc.

A representative number of data audits are completed annually. The report format of any non-conformance is similar to that of other internal audits.

The laboratory, as part of their overall internal audit program, ensures that a review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery and reporting of potential data integrity issues are handled in a confidential manner. All investigations that result in findings of inappropriate activity are fully documented, including the source of the problem, the samples and customers affected the impact on the data, the corrective actions taken by the laboratory, and which final reports had to be re-issued. Customers must be notified within 30 days after the data investigation is completed and the impact to final results is assessed.


8.1.3. Internal Audit Reports and Corrective Action Plans

Additional information can be found in SOP S-ALL-Q-011 *Audits and Inspections* or its equivalent revision or replacement.

A full description of the audit, including the identification of the operation audited, the date(s) on which the audit was conducted, the specific systems examined, and the observations noted are summarized in an internal audit report. Although other personnel may assist with the performance of the audit, the Quality Manager writes and issues the internal audit report identifying which audit observations are deficiencies that require corrective action.

When audit findings cast doubt on the effectiveness of the operations or on the correctness of validity of the laboratory's environmental test results, the laboratory will take timely corrective action and notify the customer in writing within three business days, if investigations show that the laboratory results may have been affected.

Once completed, the internal audit report is issued jointly to the Laboratory General Manager and the manager(s)/supervisor(s) of the audited operation at a minimum. The responsible manager(s)/supervisor(s) responds within 14 days with a proposed plan to correct all of the deficiencies cited in the audit report. The Quality Manager may grant additional time for responses to large or complex deficiencies (not to exceed 30 days). Each response must include timetables for completion of all proposed corrective actions.

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The Quality Manager reviews the audit responses. If the response is accepted, the Quality Manager uses the action plan and timetable as a guideline for verifying completion of the corrective action(s). If the Quality Manager determines that the audit response does not adequately address the correction of cited deficiencies, the response will be returned for modification.

To complete the audit process, the Quality Manager performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been audited and verified. This is usually within 60-90 days after implementation. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

8.2. External Audits

PASI laboratories are audited regularly by regulatory agencies to maintain laboratory certifications and by customers to maintain appropriate specific protocols.


Audit teams external to the company review the laboratory to assess the effectiveness of systems and degree of technical expertise. The Quality Manager and other QA staff host the audit team and assist in facilitation of the audit process. Generally, the auditors will prepare a formalized audit report listing deficiencies observed and follow-up requirements for the laboratory. In some cases, items of concern are discussed during a debriefing convened at the end of the on-site review process.

The laboratory staff and supervisors develop corrective action plans to address any deficiencies with the guidance of the Quality Manager. The Laboratory General Manager provides the necessary resources for staff to develop and implement the corrective action plans. The Quality Manager collates this information and provides a written response to the audit team. The response contains the corrective action plan and expected completion dates for each element of the plan. The Quality Manager follows-up with the laboratory staff to ensure corrective actions are implemented and that the corrective action was effective.

8.3. Quarterly Quality Reports

The Quality Manager is responsible for preparing a quarterly report to management summarizing the effectiveness of the laboratory Quality Systems. This status report will include:

- Overview of quality activities for the quarter
- Certification status
- Proficiency Testing study results
- SOP revision activities
- Company-wide 3P Document implementation (internal program)
- External audit findings
- Internal audit (method/system) findings
- Manual integration audit findings (Mintminer)
- Raw Data and Final Report review findings
- MDL activities
- Corrective action activities
- Training activity status

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- Other significant Quality System items

The Corporate Director of Quality utilizes the information from each laboratory to make decisions impacting the Quality Systems of the company as a whole. Each General Manager utilizes the quarterly report information to make decisions impacting Quality Systems and operational systems at a local level.

Additional information can be found in SOP S-ALL-Q-014 *Quality System Review* or its equivalent revision or replacement.

8.4. Annual Managerial Review

A managerial review of Quality Systems is performed on an annual basis at a minimum. This allows for assessing program effectiveness and introducing changes and/or improvements.

The managerial review must include the following topics of discussion:

- Suitability of quality management policies and procedures
- Manager/Supervisor reports
- Internal audit results
- Corrective and preventative actions
- External assessment results
- Proficiency testing studies
- Sample capacity and scope of work changes
- Customer feedback, including complaints
- Recommendations for improvement,
- Other relevant factors, such as quality control activities, resources, and staffing.


This managerial review must be documented for future reference by the Quality Manager and copies of the report are distributed to laboratory staff. Results should feed into the laboratory planning system and should include goals, objectives, and action plans for the coming year. The laboratory shall ensure that any actions identified during the review are carried out within an appropriate and agreed upon timescale.

8.5. Customer Service Reviews

As part of the annual managerial review listed previously, the sales staff is responsible for reporting on customer feedback, including complaints. The acquisition of this information is completed by performing surveys.

The sales staff continually receives customer feedback, both positive and negative, and reports this feedback to the laboratory management in order for them to evaluate and improve their management system, testing activities and customer service.

In addition, the labs must be willing to cooperate with customers or their representatives to clarify customer requests and to monitor the laboratory's performance in relation to the work being performed for the customers.

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9.0. CORRECTIVE ACTION

Additional information can be found in SOP S-ALL-Q-012 *Corrective Action/Preventive Action Process* or its equivalent revision or replacement.

During the process of sample handling, preparation, and analysis, or during review of quality control records, or during reviews of non-technical portions of the lab, certain occurrences may warrant the necessity of corrective actions. These occurrences may take the form of analyst errors, deficiencies in quality control, method deviations, or other unusual circumstances. The Quality System of PASI provides systematic procedures for the documentation, monitoring, completion of corrective actions, and follow-up verification of the effectiveness of these corrective actions. This can be done using PASI's LabTrack system or other system that lists among at a minimum, the deficiency by issue number, the deficiency source, responsible party, root cause, resolution, due date, and date resolved.

9.1. Corrective Action Documentation


The following items are examples of sources of laboratory deviations or non-conformances that warrant some form of documented corrective action:

- Internal Laboratory Non-Conformance Trends
- PE/PT Sample Results
- Internal and External Audits
- Data or Records Review (including non-technical records)
- Client Complaints
- Client Inquiries
- Holding Time violations

Documentation of corrective actions may be in the form of a comment or footnote on the final report that explains the deficiency (e.g. matrix spike recoveries outside of acceptance criteria) or it may be a more formal documentation (either paper system or computerized spreadsheet). This depends on the extent of the deficiency, the impact on the data, and the method or customer requirements for documentation.

The person who discovers the deficiency or non-conformance initiates the corrective action documentation on the Non-Conformance Corrective/ Preventative Action report and/or LabTrack. The documentation must include the affected projects and sample numbers, the name of the applicable Project Manager, the customer name, and the sample matrix involved. The person initiating the corrective action documentation must also list the known causes of the deficiency or non-conformance as well as any corrective/preventative actions that they have taken. Preventive actions must be taken in order to prevent or minimize the occurrence of the situation.

In the event that the laboratory is unable to determine the cause, laboratory personnel and management staff will start a root cause analysis by going through an investigative process. During this process, the following general steps must be taken into account: defining the non-conformance, assigning responsibilities, determining if the condition is significant, and investigating the root cause of the nonconformance. General non-conformance investigative techniques follow the path of the sample through the process looking at each individual step in detail. The root cause must be documented within LabTrack or on the Corrective/Preventative Action Report.

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After all the documentation is completed, the routing of the Corrective/Preventative Action Report and /or Lab Track will continue from the person initiating the corrective action, to their immediate supervisor or the Project Manager and finally to the Quality Manager, who is responsible for final review and signoff of all formal corrective/preventative actions.

In the event that analytical testing or results do not conform to laboratory procedures or customer requirements, the laboratory shall investigate the significance of the non-conformance and take appropriate corrective actions. Where necessary, the customer is notified and work is recalled. The procedures for handling non-conforming work are detailed in SOP S-ALL-Q-012 *Corrective Action/Preventive Action Process* or its equivalent revision or replacement.

9.2. Corrective Action Completion

9.2.1. Internal Laboratory Non-Conformance Trends


There are several types of non-conformance trends that may occur in the laboratory that would require the initiation of a corrective action report. Laboratories may choose to initiate a corrective action for all instances of one or more of these categories if they so choose, however the intent is that each of these would be handled according to its severity; one time instances could be handled with a footnote or qualifier whereas a systemic problem with any of these categories may require an official corrective action process. These categories, as defined in the Corrective Action SOP are as follows:

- Login error
- Preparation Error
- Contamination
- Calibration Failure
- Internal Standard Failure
- LCS Failure
- Laboratory accident
- Spike Failure
- Instrument Failure
- Final Reporting error

9.2.2. PE/PT Sample Results

Any PT result assessed as “not acceptable” requires an investigation and applicable corrective actions. The operational staff is made aware of the PT failures and they are responsible for reviewing the applicable raw data and calibrations and list possible causes for error. The Quality Manager reviews their findings and initiates another external PT sample or an internal PT sample to try and correct the previous failure. Replacement PT results must be monitored by the Quality Manager and reported to the applicable regulatory authorities.

9.2.3. Internal and External Audits

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The Quality Manager is responsible for documenting all audit findings and their corrective actions. This documentation must include the initial finding, the persons responsible for the corrective action, the due date for responding to the auditing body, the root cause of the finding, and the corrective actions needed for resolution. The Quality Manager is also responsible for providing any back-up documentation used to demonstrate that a corrective action has been completed.

9.2.4. Data Review

In the course of performing primary and secondary review of data or in the case of raw data reviews (e.g. by the Quality Manager), errors may be found which require corrective actions. Any finding that affects the quality of the data requires some form of corrective action, which may include revising and re-issuing of final reports.

9.2.5. Client Complaints

Project Managers are responsible for issuing corrective action forms, when warranted, for customer complaints. As with other corrective actions, the possible causes of the problem are listed and the form is passed to the appropriate analyst or supervisor for investigation. After potential corrective actions have been determined, the Project Manager reviews the corrective action form to ensure all customer needs or concerns are being adequately addressed.

9.2.6. Client Inquiries

When an error on the customer report is discovered, the Project Manager is responsible for initiating a formal corrective action form that describes the failure (e.g. incorrect analysis reported, reporting units are incorrect, reporting limits do not meet objectives). The Project Manager is also responsible for revising the final report if necessary and submitting it to the customer.

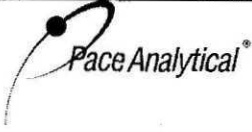
9.2.7. Holding Time Violations

In the event that a holding time has been missed, the analyst or supervisor must complete a formal corrective action form. The Project Manager and the Quality Manager must be made aware of all holding time violations.

The Project Manager must contact the customer in order that appropriate decisions are made regarding the hold time excursion and the ultimate resolution is then documented and included in the customer project file. The Quality Manager includes a list of all missed holding times in their Quarterly Report to the corporate QA office.


9.3. Preventive Action Documentation

Pace laboratories can take advantage of several available information sources in order to identify needed improvements in all of their systems including technical, managerial, and quality. These sources may include:

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- Management Continuous Improvement Plan (CIP) metrics which are used by all production departments within Pace. When groups compare performance across the company, ways to improve systems may be discovered. These improvements can be made within a department or laboratory-wide.
- Annual managerial reviews- part of this NELAC required and NVLAP required review is to look at all processes and procedures used by the laboratory over the past year and to determine ways to improve these processes in the future.
- Quality systems reviews- any frequent checks of quality systems (monthly logbook reviews, etc.) can uncover issues that can be corrected or adjusted before they become a larger issue.

When improvement opportunities are identified or if preventive action is required, the laboratory can develop, implement, and monitor preventive action plans.


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10.0. GLOSSARY


3P Program	The Pace Analytical continuous improvement program that focuses on Process, Productivity, and Performance. Best Practices are identified that can be used by all PASI labs.
Acceptance Criteria	Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of NELAP, this process is voluntary.
Accrediting Authority	The Territorial, State or Federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.
Accrediting (or Accreditation) Body	Authoritative body that performs accreditation.
Accuracy	The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot	A discrete, measured, representative portion of a sample taken for analysis.
Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analyst	The designated individual who performs the "hands-on" analytical methods and associated techniques and who is responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analyte	The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family, and which are analyzed together.
Analytical Uncertainty	A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Assessment	The evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria (this is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection or surveillance).
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	A process in which a sample is converted to free atoms.
Audit	A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

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Batch	Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.
Bias	The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blind Sample	A sample submitted for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test analyst or laboratory proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.
Calibration	Set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of Reference Standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.
Calibration Curve	The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	A defined technical procedure for performing a calibration.
Calibration Range	The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	A substance or reference material used to calibrate an instrument.

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Certified Reference Material (CRM)	A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.
Chain of Custody	An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of custody Form (COC)	A record that documents the possession of samples from the time of collection to receipt in the laboratory. This record generally includes the number and type of containers, mode of collection, collector, time of collection, preservation, and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	<p>The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is:</p> $\% \text{ Completeness} = (\text{Valid Data Points} / \text{Expected Data Points}) * 100$
Confirmation	<p>Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:</p> <ul style="list-style-type: none"> • second-column confirmation; • alternate wavelength; • derivatization; • mass spectral interpretation; • alternative detectors; or • additional cleanup procedures.
Conformance	An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the <i>state of meeting the requirements</i> .
Congener	A member of a class of related chemical compounds (e.g. PCBs, PCDDs).
Consensus Standard	A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.

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Continuing Calibration Verification	The verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a CVS in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.
Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Corrective Action	The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Data Audit	A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e. that they meet specified acceptance criteria).
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more usable form.
Definitive Data	Analytical data of known quality, concentration and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making.
Demonstration of Capability	A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.
Detection Limit (DL)	The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate is 1%.

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Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).
Digestion	A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form.
Document Control (Management)	The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled (managed) to ensure use of the correct version at the location where the prescribed activity is performed.
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (or Replicate)	The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g. PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	A solvent used to carry the components of a mixture through a stationary phase.
Elute	To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	The process of measuring or collecting environmental data.
Environmental Sample	<p>A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows:</p> <ul style="list-style-type: none"> • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.

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False Negative	An analyte incorrectly reported as absent from the sample, resulting in potential risks from their presence.
False Positive	An item incorrectly identified as present in the sample, resulting in a high reporting value for the analyte of concern.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Finding	An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative and is normally accompanied by specific examples of the observed condition. (For DoD, the finding must be linked to a specific requirement).
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised (40 CFR Part 136). (DoD) The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member.

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Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP-AES that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Verification (ICV)	A standard obtained or prepared from a source independent of the source of the standards for the initial calibration. Its concentration should be at or near the middle of the calibration range. It is done after the initial calibration.
Inspection	An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic.
Instrument Blank	A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Interference, spectral	Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standards	A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties.

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Laboratory Control Sample (LCS)	(however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of the total analytical system, including all preparation and analysis steps.
Laboratory Duplicate	Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
LabTrack	Database used by Pace Analytical to store and track corrective actions and other laboratory issues.
Learning Management System (LMS)	A training database used by Pace Analytical to train their employees. This system is a self-paced system which is capable of tracking all employee training requirements and documentation.
Legal Chain of custody	Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit of Detection (LOD)	(TNI) An estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect. (DoD) The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.
Limit of Quantitation (LOQ)	(TNI) The minimum levels, concentrations or quantities of a target variable (e.g. target analyte) that can be reported with a specified degree of confidence. (DoD) The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.
Lot	A quantity of bulk material of similar composition processed or manufactured at the same time.
Management	Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	System to establish policy and objectives and to achieve those objectives.

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Manager (however named)	The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	The substrate of a test sample.
Matrix Duplicate	A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of precision of the recovery of each analyte.
Method	A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis) systematically presented in the order in which they are to be executed.
Method Blank	A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures: and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Method Detection Limit (MDL)	One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
MintMiner	Program used by Pace Analytical to review large amounts of chromatographic data to monitor for errors or data integrity issues.
National Institute of Standards and Technology (NIST)	A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).
National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.

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Nonconformance	An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Performance Audit	The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	Any conditions under which a sample must be kept in order to maintain the chemical and/or biological integrity of the sample.
Proficiency Testing	A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.
Proficiency Testing Sample	A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within the specified acceptance criteria.
Protocol	A detailed written procedure for field and/or laboratory operation that must be strictly followed.
Quality Assurance (QA)	<p>(TNI) An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.</p> <p>(DoD) An integrated system of activities involving planning, quality control, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.</p>

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Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.
Quality Control Sample (QCS)	A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.
Quality Manual	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality System	A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

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Quality System Matrix	<p>These matrix definitions are to be used for purposes of batch and quality control requirements:</p> <ul style="list-style-type: none"> • Air and Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin • Chemical Waste: A product or by-product or an industrial process that results in a matrix not previously defined. • Drinking Water: Any aqueous sample that has been designated a potable or potentially potable water source. • Non-aqueous liquid: Any organic liquid with <15% settleable solids • Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other saltwater source such as the Great Salt Lake. • Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	The range of values in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard. The quantitation range lies within the calibration range.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.
Reagent Blank (method reagent blank)	A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Reference Material	A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

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Reference Standard	<p>(TNT) Standard used for the calibration of working measurement standards in a given organization or at a given location.</p> <p>(DoD) A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.</p>
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Reporting Limit (RL)	<p>The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e. statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL.</p> <p>(DoD) A client-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.</p>
Reporting Limit Verification Standard (or otherwise named)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	Denotes a mandatory specification; often designated by the term "shall".
Retention Time	The time between sample injection and the appearance of a solute peak at the detector.
Sample	Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by Pace Analytical sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).
Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selective Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.

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Selectivity	The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.
Sensitivity	The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Shall	Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio	The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. In most measurements, the average strength of the noise is constant and independent of the magnitude of the signal. Thus, the effect of noise on the relative error of a measurement becomes greater and greater as the quantity being measured (producing the signal) decreases in magnitude.
Spike	A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.
Standard (Chemical)	Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks
Standard Reference Material (SRM)	A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.

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Supervisor	The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	Analytes specifically named by a client (also called project-specific analytes).
Technical Director	Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Test	A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	An adoption of a scientific technique for performing a specific measurement as documented in a laboratory SOP or as published by a recognized authority.
Test Methods for Evaluating Solid Waste, Physical/Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.
Traceability	<p>The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.</p> <p>(DoD) The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.</p>
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	A check and/or adjustment of instrument performance for mass spectrometry as required by the method.


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Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty Measurement	The parameter associated with the result of a measurement that characterized the dispersion of the values that could be reasonably attributed to the measurand (i.e. the concentration of an analyte).
Validation	The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	<p>Confirmation by examination and objective evidence that specified requirements have been met.</p> <p>(DoD) Note: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.</p>
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).


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11.0. REFERENCES

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12.0. REVISIONS

The PASI Corporate Quality Office files both a paper copy and electronic version of a Microsoft Word document with tracked changes detailing all revisions made to the previous version of the Quality Assurance Manual. This document is available upon request. All revisions are summarized in the table below.


Document Number	Reason for Change	Date
Quality Assurance Manual revision 13.0	<p>Increased font size of entire document.</p> <p>Section 1.7, fifth paragraph: changed length of time Technical Director can be gone before contacting primary authority (from 65 down to 35 days per TNI standard).</p> <p>Section 1.8.2: Reworded definition for Assistant GM to say "all departments".</p> <p>Fixed numbering issue with sub-sections for section 1.8 and used bullet points instead of numbers.</p> <p>Section 1.8.19: revised position title to capture requirement of some labs.</p> <p>Section 1.9: added language to second bullet point regarding LMS.</p> <p>Section 1.9: added bullet point for on-line courses.</p> <p>Section 2.5: added third note per request from GB (in red text).</p> <p>Section 2.6: Added chart of 2-digit codes (laboratory designations) per audit finding from GB laboratory (matches corporate SOPs).</p> <p>Section 2.7.4: added reference for Waste Handling and Management SOT.</p> <p>Section 3.1: added more method agency references.</p> <p>Section 3.4: added reference to Training SOP at end of section.</p> <p>Section 4.1: fixed numbering issue. Removed anonymous phone number and added reference to the Employee Handbook.</p> <p>Section 4.2: added paragraph of Ohio VAP required language (red text).</p> <p>Section 4.3, fifth paragraph: reworded second sentence for clarity.</p> <p>Section 4.3: added paragraphs of Ohio VAP and DoD required language (red text).</p> <p>Section 4.4, first paragraph: added qualifier to end of paragraph that MS limits are used to assess the batch if the MS is used in place of the LCS.</p> <p>Section 4.4: added paragraph of Ohio VAP required language (red text).</p> <p>Section 4.6: added paragraph of Ohio VAP required language (red text).</p> <p>Section 4.7: added paragraph of Ohio VAP required language (red text).</p> <p>Section 4.10: added paragraph of Ohio VAP required language (red text).</p> <p>Section 4.11: added paragraph of DoD required language (red text).</p> <p>Section 5.1, fifth paragraph: changed wording from LAN/WAN to local server (as opposed to hardcopies) and added language about LMS access.</p> <p>Section 5.1.2: added paragraphs of Ohio VAP and DoD required language (red text).</p> <p>Added new section 5.3- Management of Change.</p> <p>Section 6.2.1: added paragraph of Ohio VAP required language (red text).</p> <p>Section 6.3.2: changed NIST thermometer calibration frequency to every 3 years to match current practice.</p> <p>Section 7.3: added comment about Ohio VAP reporting (red text).</p> <p>Section 8.1.2, last sentence: reworded to match current practice.</p> <p>Section 8.1.3, last paragraph: reworded sentences regarding verification of corrective actions.</p> <p>Section 8.3: revised list of Quarterly Quality report items to match the revised SOP.</p> <p>Section 8.4: added last two bullet points and added second line of last paragraph to match ISO language.</p> <p>Section 9.1: changed bullet point items to match CAR SOP.</p> <p>Section 9.2.1: revised language to match SOP.</p> <p>Section 9.2.2: moved language from old 9.2.8 to 9.2.2.</p> <p>Section 9.2.4: added language to data review section.</p>	30Apr2010

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	<p>Glossary: Added definitions for analytical uncertainty, audit, bias, field of accreditation, finding, legal COC, matrix duplicate, method, PT sample, sampling, verification (per TNI standard).</p> <p>Glossary: Added definitions for reporting limit verification standard and initial calibration verification per request.</p> <p>Glossary: revised the following definitions to match new TNI language: DOC, LCS, LOD, MS, MSD, preservation, QA, QC, QC sample, raw data, reference standard, SOPs, and traceability. Also revised language within the definition for Quality System Matrix (previously just called Matrix).</p> <p>Glossary: deleted definition for 'detection limit'.</p> <p>Glossary: added definitions from company Acronym form from IT.</p> <p>Glossary: added definitions for LabTrack and MintMiner.</p> <p>Attachment VIII: added more tests to the chart per QM input including a line item for concentrated waste matrix for VOA 8260.</p> <p>General: changed all references to "Director of Quality, Safety, and Training" to "Director of Quality".</p> <p>General: revised document references to SOTs for Waste Handling and Management and Sample Management.</p> <p>Removed corporate org chart from Attachment IIB and will provide this as a separate document to the QMs. In this way, revisions to the corporate org chart will not necessitate a new QAM revision.</p>	
Quality Assurance Manual 14.0	<p>Cover page: moved signatures to cover page; added new form identification box in header. Added names of signatories</p> <p>Section 1.1 edited for clarity</p> <p>Section 1.3: added language to 3rd paragraph regarding compliance with method and client requirements (TNI V1M2, section 4.2). edited for clarity</p> <p>Section 1.4: Added language describing each of the Core Values, including wording from TNI V1M2, section 4.1 into the "Value Employees" line item.</p> <p>Section 1.5 added fourth bullet point</p> <p>Sections 1.6.2, 1.6.2, 1.6.3, 1.6.4 edited for clarity</p> <p>Section 1.7 edited for clarity</p> <p>Section 1.8.4: added bullet point to QM responsibilities pertaining to corrective actions (TNI V1M2, section 4.1.7.1).</p> <p>Section 1.8.4: added bullet point to QM responsibilities pertaining to the QAM (TNI V1M2, section 4.2.8.2).</p> <p>Section 1.9: reworded and reorganized parts of this section to match current practices using the LMS and for clarity.</p> <p>Section 1.10: moved Data Integrity section from Chapter 4 to Chapter 1. edited for clarity.</p> <p>Section 1.11 edited for clarity</p> <p>Sections 2.1, 2.3, 2.4, 2.5, 2.8, 2.9, 2.10 edited for clarity</p> <p>Section 2.5: added additional bullet point regarding qualified data (TNI V1M2, section 5.8.6.g).</p> <p>Section 2.6: added DoD red letter paragraph regarding time of collection (DoD gray box 14).</p> <p>Section 2.7.1: added new second paragraph to discuss storage blanks (DoD gray box 19).</p> <p>Section 2.7.2: reworded 2nd paragraph- temperatures are checked and documented each day of use (TNI V1M2, section 5.5.13.1.d).</p> <p>Section 2.9: added red letter section to the end of this section regarding DoD subcontract labs (DoD gray box 10).</p> <p>Section 2.9: added wording to the end of the fifth paragraph in this section regarding providing copies of subcontract reports to the client (TNI V1M2, section 4.5.5).</p> <p>3.1 removed A2LA nad NVLAP and added Standard methods</p> <p>Section 3.2, 3.3 edited for clarity</p> <p>Section 3.4: added phrase to first paragraph (TNI V1M4, section 1.6.1).</p> <p>Section 3.4: added language about running DOC if a method had not been</p>	17Feb2011

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	<p>run for 12 months (TNI V1M4, section 1.6.2). Also removed language regarding 'work cells' (removed from TNI standard).</p> <p>Section 4.0: new general paragraph added to explain specifics regarding QC samples (TNI V1M2, section 5.9 and DoD gray box 45).</p> <p>Section 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.9, 4.10, 4.12 edited for clarity</p> <p>Section 4.1: added DoD red letter paragraph regarding method blank contamination (DoD gray box D-1).</p> <p>Section 4.1: added new 4th paragraph regarding method blanks (TNI V1M4, section 1.7.3.1.d).</p> <p>Section 4.2: added wording to 5th paragraph regarding exceedance of LCS limits and data qualifiers (TNI V1M4, section 1.7.4.2.a.i and ii).</p> <p>Section 4.3: added red-letter paragraph regarding MS/MSD requirements for DoD (DoD gray boxes D-7 and D-8).</p> <p>Section 4.4: added wording to 2nd paragraph regarding client-specific surrogate criteria (DoD gray box D-12).</p> <p>Section 4.10: removed sentence from 2nd paragraph ('sufficient buffer' was too vague).</p> <p>Section 4.11: adjusted title of section.</p> <p>Section 5.1: added reference to electronic signature policy in Document Mgmt SOP (TNI V1M2, section 4.2.8.4.r).</p> <p>Section 5.1.2: added language to DoD red letter paragraph (DoD gray box 20).edited for clarity</p> <p>Section 6.1: rewrote 5th paragraph to compensate for change in TNI language regarding second source standards (TNI V1M4, section 1.7.1.1.d). Added small vial labeling requirement. Added paragraph about minimum requirements for labeling.</p> <p>Section 6.2, 6.2.1, 6.2.2, 6.3, 6.3.5, 6.4, 7.3, 8.1.1, 8.4 edited for clarity</p> <p>Section 6.3: rewrote 2nd paragraph- that all measurements are performed on each day if use and documented (TNI V1M2, section 5.5.13.1.d).</p> <p>Section 6.3.1 added "bracketing the range of use" also edited for clarity</p> <p>Section 7.2: added additional red-letter section for DoD data review steps to be added (DoD gray box 44) and added reference to Data Review SOP.</p> <p>Section 7.3: added DoD red letter paragraph regarding the recording of sample prep and analysis time on final reports (DoD gray box 14).</p> <p>Section 7.3: Added extra requirements for final reports when needed for interpretation of results (TNI V1M2, section 5.10).</p> <p>Section 8.4: edited for clarity</p> <p>Section 9.1: added paragraph regarding non-conforming work (TNI V1M2, section 4.9).</p> <p>Section 9.2.1 added login error</p> <p>Section 9.3 edited for clarity</p> <p>Section 11: added DoD QSM version 4.2 as a reference.</p> <p>Glossary: added definitions for NIST, reference material, standard (document), selectivity, acceptance criteria, accreditation, accrediting authority, accrediting body, analyst, assessment, atomization, calibration method, calibration range, calibration standard, certified reference material, chain of custody (as opposed to COC form), client (customer), congener, conformance, consensus standard, continuing calibration verification (as opposed to CCV standard), data audit, definitive data, detection limit, digestion, eluent, elute, elution, environmental data, environmental monitoring, homologue, inspection, interference (spectral and chemical), SI, instrument blank, isomer, laboratory duplicate, LOQ (added DoD version), manager, management, management system, matrix, method of standard additions, negative control, nonconformance, performance audit, positive control, quality manual, quantitation range, reagent blank, reference standard (DoD version), reporting limit (DoD version), requirement, retention time, sample, shall, should, signal-to-noise ratio, spike, standard method, standard reference material, supervisor, target analytes, technical</p>	

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	<p>director, test, test method, traceability (DoD version), tuning, validation. Glossary: revised definitions for standard (chemical), accuracy, aliquot, analyte, batch, calibration, calibration curve, confirmation, corrective action, document control, duplicate, finding, holding time (added DoD version too), LCS, LOD (added DoD version too), MDL (adopted DoD clarification since TNI dropped MDL), precision, PT sample, quality assurance (added DoD version), QAPP, raw data, ICV, verification (added DoD note). Glossary: removed definition for calibration verification. Removed reference to SOP S-ALL-Q-036, Management of Change</p>	

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ATTACHMENT I- QUALITY CONTROL CALCULATIONS

PERCENT RECOVERY (%REC)

$$\%REC = \frac{(MSConc - SampleConc)}{TrueValue} * 100$$

NOTE: The SampleConc is zero (0) for theLCS and Surrogate Calculations

PERCENT DIFFERENCE (%D)

$$\%D = \frac{MeasuredValue - TrueValue}{TrueValue} * 100$$

where:

TrueValue = Amount spiked (can also be the \overline{CF} or \overline{RF} of the ICAL Standards)

Measured Value = Amount measured (can also be the CF or RF of the CCV)

PERCENT DRIFT

$$\%Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentration} * 100$$

RELATIVE PERCENT DIFFERENCE (RPD)

$$RPD = \frac{|(R1 - R2)|}{(R1 + R2) / 2} * 100$$

where:


R1 = Result Sample 1

R2 = Result Sample 2

CORRELATION COEFFICIENT (R)

$$CorrCoeff = \frac{\sum_{i=1}^N W_i * (X_i - \bar{X}) * (Y_i - \bar{Y})}{\sqrt{\left(\sum_{i=1}^N W_i * (X_i - \bar{X})^2 \right) * \left(\sum_{i=1}^N W_i * (Y_i - \bar{Y})^2 \right)}}$$

With: N Number of standard samples involved in the calibration
i Index for standard samples
Wi Weight factor of the standard sample no. i
Xi X-value of the standard sample no. i
X(bar) Average value of all x-values
Yi Y-value of the standard sample no. i
Y(bar) Average value of all y-values

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ATTACHMENT I- QUALITY CONTROL CALCULATIONS (CONTINUED)

STANDARD DEVIATION (S)

$$S = \sqrt{\sum_{i=1}^n \frac{(X_i - \bar{X})^2}{(n-1)}}$$

where:

n = number of data points
 X_i = individual data point
 \bar{X} = average of all data points

AVERAGE (\bar{X})

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

where:


n = number of data points
 X_i = individual data point

RELATIVE STANDARD DEVIATION (RSD)

$$RSD = \frac{S}{\bar{X}} * 100$$

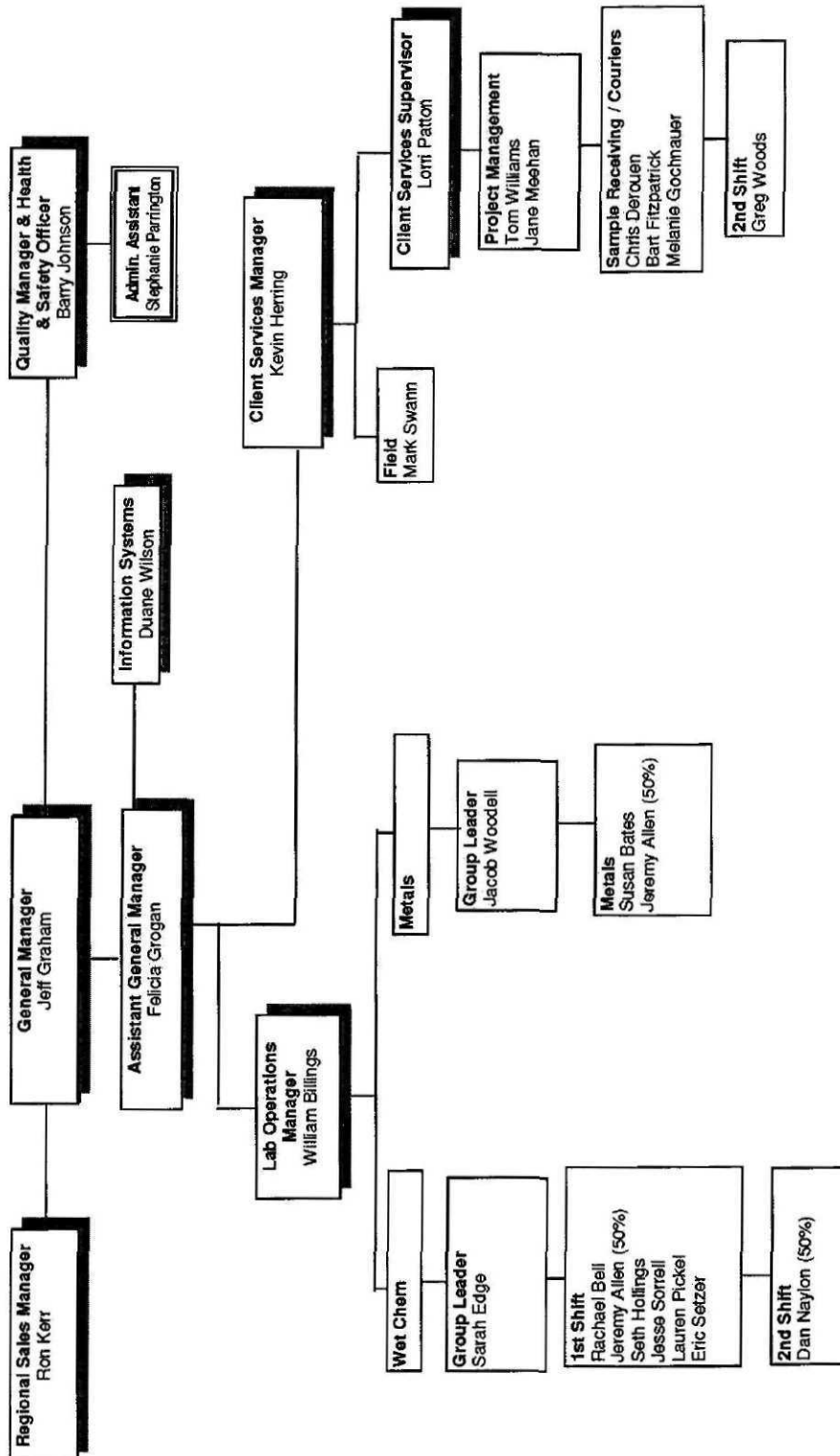
where:


S = Standard Deviation of the data points
 \bar{X} = average of all data points

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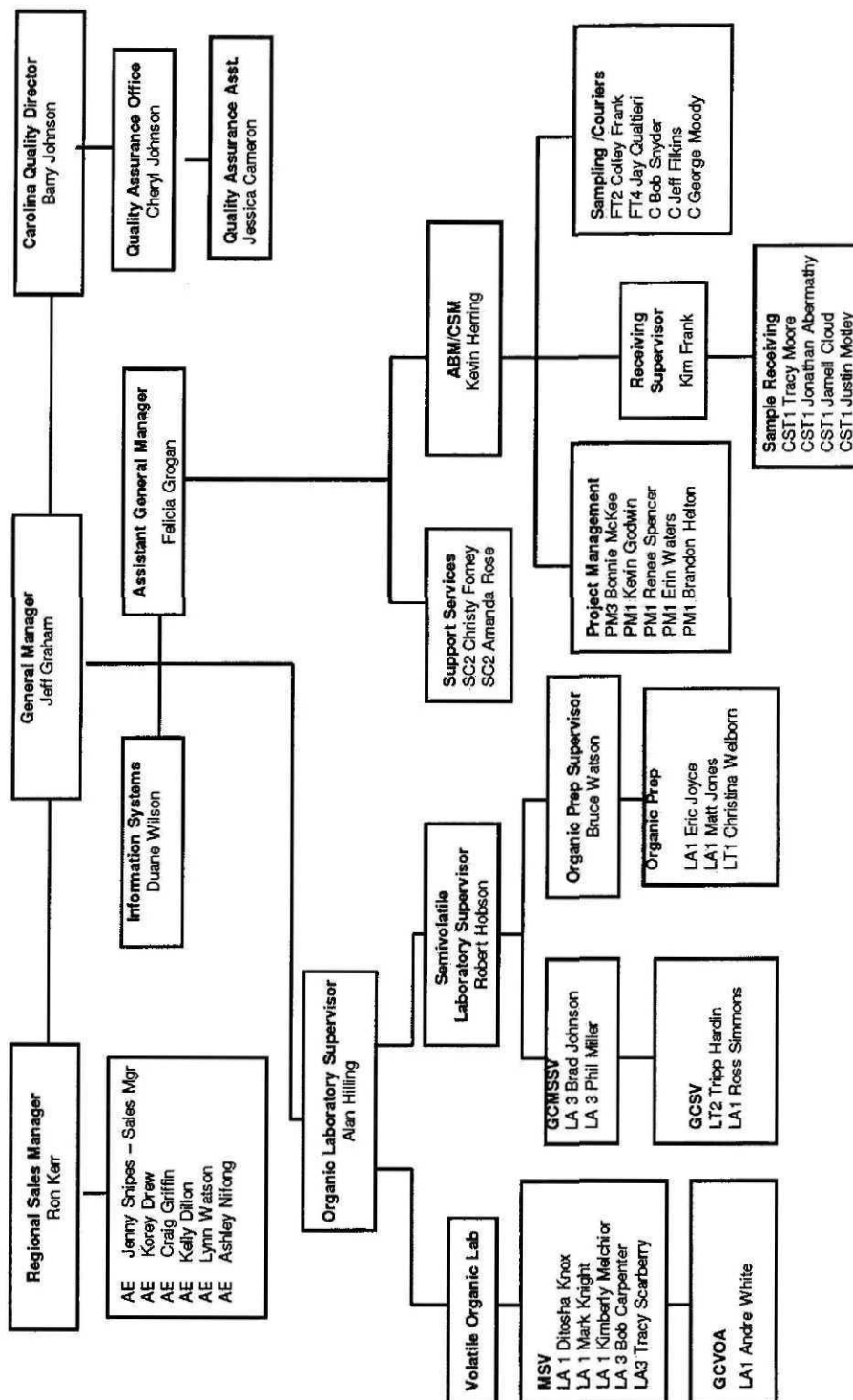
ATTACHMENT IIA- PASI – ASHEVILLE ORGANIZATIONAL CHART


CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-AVL QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.



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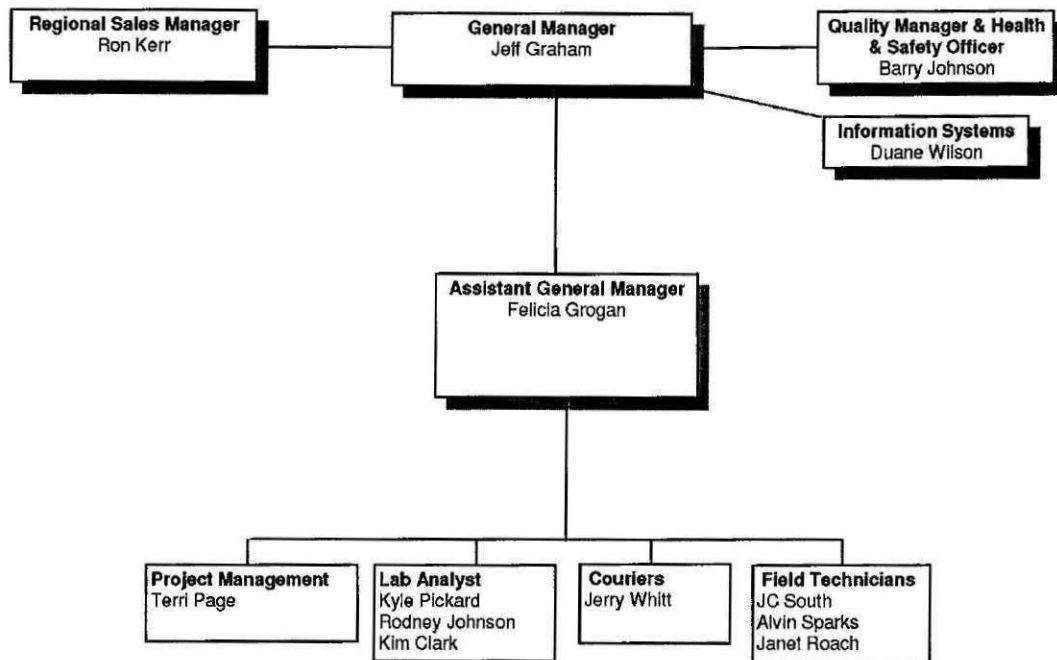
ATTACHMENT IIA- PASI – CHARLOTTE ORGANIZATIONAL CHART
CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-CHR QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.



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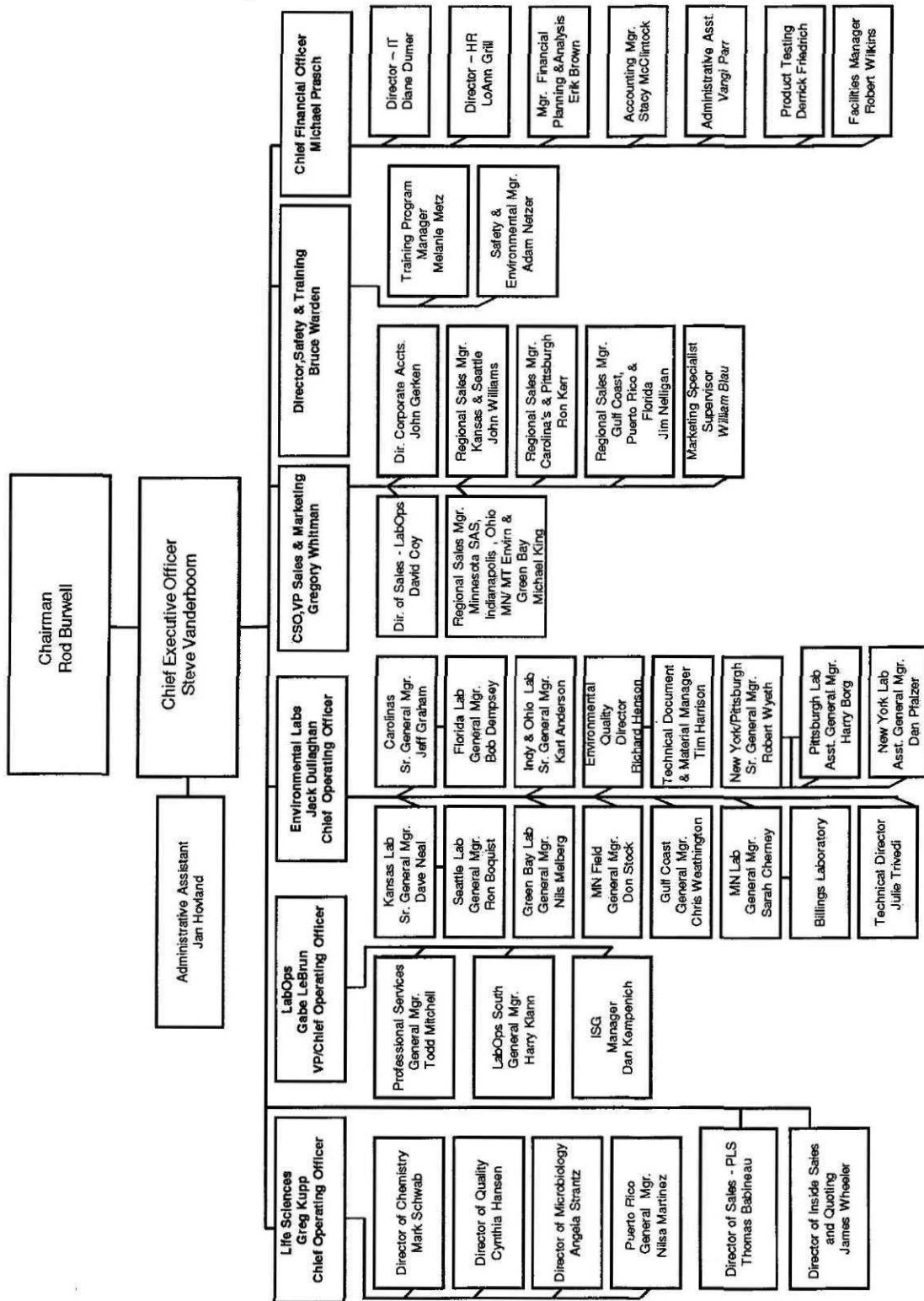
ATTACHMENT IIA- PASI – EDEN ORGANIZATIONAL CHART


CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-EDN QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.



ATTACHMENT IIB- CORPORATE ORGANIZATIONAL CHART

CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-CAROLINAS QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.




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ATTACHMENT III- PASI-ASHEVILLE EQUIPMENT LIST

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Department	Equipment	Model	Vendor	Serial Number	Analysis
Metals	ICP	61E Trace	Thermo Elemental	311490	Metals
Metals	ICP	Vista Pro	Varian	EL06024119	Metals
Metals	Mercury analyzer	M7500	CETAC	100402QTA	Mercury
Metals	Hot Block (1)	96 position	Environmental Express	N/A	Metals
Metals	Hot Block (4)	54 position	Environmental Express	N/A	Metals
Wet Chemistry	Analytical Balance	AE 100	Mettler	T60048	Mercury Prep
Wet Chemistry	Analytical Balance	200DS	Fisher	BO27039	TSS, TDS, reagents
Wet Chemistry	Balance	PE 400	Mettler	B2915	
Wet Chemistry	Analytical Balance	AB54-S/FACT	Mettler	1126450078	Bioassay
Wet Chemistry	Analytical Balance	xs105DU	Mettler Toledo AG	1129312116	Solids / Other
Wet Chemistry	Expandable Ion Analyzer	EA 420A	Orion	QU08A	pH
Wet Chemistry	Expandable Ion Analyzer	510	Oaklon	1543885	pH
Wet Chemistry	Expandable Ion Analyzer	EA 940	Orion	R030A	Residual Chlorine
Wet Chemistry	COD Reactors (3)	45600	HACH	900602688	COD
Wet Chemistry	COD Reactors (1)	45600	HACH	900601686	COD
Wet Chemistry	Flow Injection Analysis (FIA)	QuickChem 8000	Lachat	A83000-1064	nitrate + nitrite
Wet Chemistry	Midi-Distillation	1023	Westco Scientific	N/A	Phenol and Ammonia
Wet Chemistry	Midi-Distillation (2)	N/A	Lachat Micro Dist.	A2000-835	Cyanide
Wet Chemistry	Turbidimeter	2100A	HACH	900621279	Turbidity
Wet Chemistry	Oven	655F	Fisher Isotemp	004q0125	TDS <100°C
Wet Chemistry	Oven	655P	Precision STM 80	11AY-2	TDS 180°C
Wet Chemistry	Oven	650G	Fisher Isotemp	40026	TSS Oven
Wet Chemistry	BOD meter	5100	YSI	00K0582	BOD

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Department	Equipment	Model	Vendor	Serial Number	Analysis
Wet Chemistry	Konelab	Aqua 20	Thermo	S1719157	Orthophosphate and Hexavalent Chromium
Wet Chemistry	Incubator	1530	VWR	N/A	Total Coliform 35°C
Wet Chemistry	Autoclave	N/A	Market Forge	N/A	Sterilization
Wet Chemistry	Block Digester Controller	Aim600	N/A	4826A13455	TKN
Wet Chemistry	TOC Analyzer	TOC-Vcpm	Shimadzu	H51404535060CS	TOC
Wet Chemistry	Spec 20	4001	Spectronic 20 Genesys	3SGD037010	Sulfide/ COD
Wet Chemistry	Flashpoint	K16200	Koehler	R07002317	Flashpoint
Wet Chemistry	IC	761	Metrohm	11145	
Wet Chemistry	IC	788	Metrohm	4119	

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ATTACHMENT III- PASI-CHARLOTTE EQUIPMENT LIST

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Department	Equipment	Model	Vendor	Serial Number	Analysis
Client Services	Analytical Balance	AM100	Mettler	H44504	Percent Moisture
Client Services	Incubator	Isotemp 503	Fisher		Total Coliform (SM 9223B)
Client Services	Water Bath	Coliform Incubator Bath	Precision		Fecal Coliform (SM 9222D)
Client Services	Oven	DK43	Baxter	A04356	Percent Moisture
Client Services	Oven	Isotemp	Fisher		Percent Moisture
Client Services	pH Meter	Accumet AP61	Fisher	220713	pH
Extractions	Microwave Extractor	MARSX	CEM	PASI19706	Soil Extraction (3546)
Extractions	Solid Phase Extractor	3000XL	Horizon	03-1169	Oil&Grease (1664A)
Extractions	Solid Phase Extractor	3000XL	Horizon	01-1130	Oil&Grease (1664A)
Extractions	Concentrator	5000	Horizon	1008	Concentration
Extractions	Concentrator	5000	Horizon	1065	Concentration
Extractions	Concentrator	5000	Horizon	1093	Concentration
Extractions	Concentrator	5000	Horizon	1092	Concentration
Extractions	Concentrator	9000	Horizon	02-0369	Concentration (1664A, 9071B)
Extractions	Concentrator	9000	Horizon	00-284	Concentration (1664A, 9071B)
Extractions	Analytical Balance	R200D	Sartorius	40040069	Extractions
Extractions	Oven	5890 Series II	Hewlett-Packard		
Extractions	Oven	5890 Series II	Hewlett-Packard		
Extractions	Oven	31609	Thelco	9606-003	
Extractions	Top-loading Balance	SP601	Ohaus	7130431003	Extractions
Extractions	Shaker	3D Shaker	Glas-Col		Water extractions
Extractions	Water Bath	Isotemp 120	Fisher		Concentration
Extractions	Analytical Evaporator	120	Organomation	10723	Concentration
Extractions	Top-loading Balance	SP601	Ohaus	7131280840	Extractions

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Department	Equipment	Model	Vendor	Serial Number	Analysis
Semivolatiles	Gas Chromatograph	5890 Series II, Dual FID	Hewlett-Packard	3223A42590	DRO, ORO
Semivolatiles	Gas Chromatograph	6890, Dual FID	Hewlett-Packard	US00042026	Mass EPH
Semivolatiles	Gas Chromatograph	6890, Dual micro ECD	Hewlett-Packard	US00043919	8011, 504.1, 552.2, 8081B, 8082A
Semivolatiles	Gas Chromatograph	6890N, Dual micro ECD	Hewlett-Packard	CN10426006	8011, 504.1, 552.2, 8081B, 8082A
Semivolatiles	Gas Chromatograph	6890, Dual FID	Hewlett-Packard	CN10820003	DRO
Semivolatiles	Gas Chromatograph / Mass Spectrometer	7890A, MS-5970C	Agilent	CN10816094, US80819094	8270D, 625, 8270D SIM
Semivolatiles	Gas Chromatograph / Mass Spectrometer	7890A, MS-5975C	Hewlett-Packard	CN10031110, US10040001	8270D, 625, 8270D SIM
Semivolatiles	Gas Chromatograph / Mass Spectrometer	6890N, MS-5975C	Agilent	US10628085, US81819411	8270D, 625, 8270D SIM
Semivolatiles	Top-loading Balance	PM2500	Mettler	K59661	8011, 504.1 extractions
Semivolatiles	Rotator	TCLP Rotator			TCLP Tumbling
Volatiles	Gas Chromatograph	5890A Series II, PID/FID	Hewlett-Packard	2921A23623	Mass VPH
Volatiles	Gas Chromatograph	5890E, PID/FID	Hewlett-Packard	3336A56045	GRO
Volatiles	Gas Chromatograph / Mass Spectrometer	6890, MS-5973	Hewlett-Packard	CN10430013, US43146820	8260B
Volatiles	Gas Chromatograph / Mass Spectrometer	5890 Series II, MS-5972	Hewlett-Packard	2921A24454, 3341A02064	8260B
Volatiles	Gas Chromatograph / Mass Spectrometer	6850, MS-5975C	Agilent	NC10805009, US92012898	6200B
Volatiles	Gas Chromatograph / Mass Spectrometer	5890 Series II, MS-5972	Hewlett-Packard	3310A48420, 3341A01003	8260B

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Department	Equipment	Model	Vendor	Serial Number	Analysis
Volatiles	Gas Chromatograph / Mass Spectrometer	6890, MS-5937	Agilent	US00026359, US82322063	8260B
Volatiles	Gas Chromatograph / Mass Spectrometer	6850, MS-5975C	Agilent	CN10802003, US80118209	8260B
Volatiles	Top-loading Balance	SC4010	Ohaus	BJ436720	Volatiles
Volatiles	Top-loading Balance	SP202	Ohaus	7123170886	Volatiles

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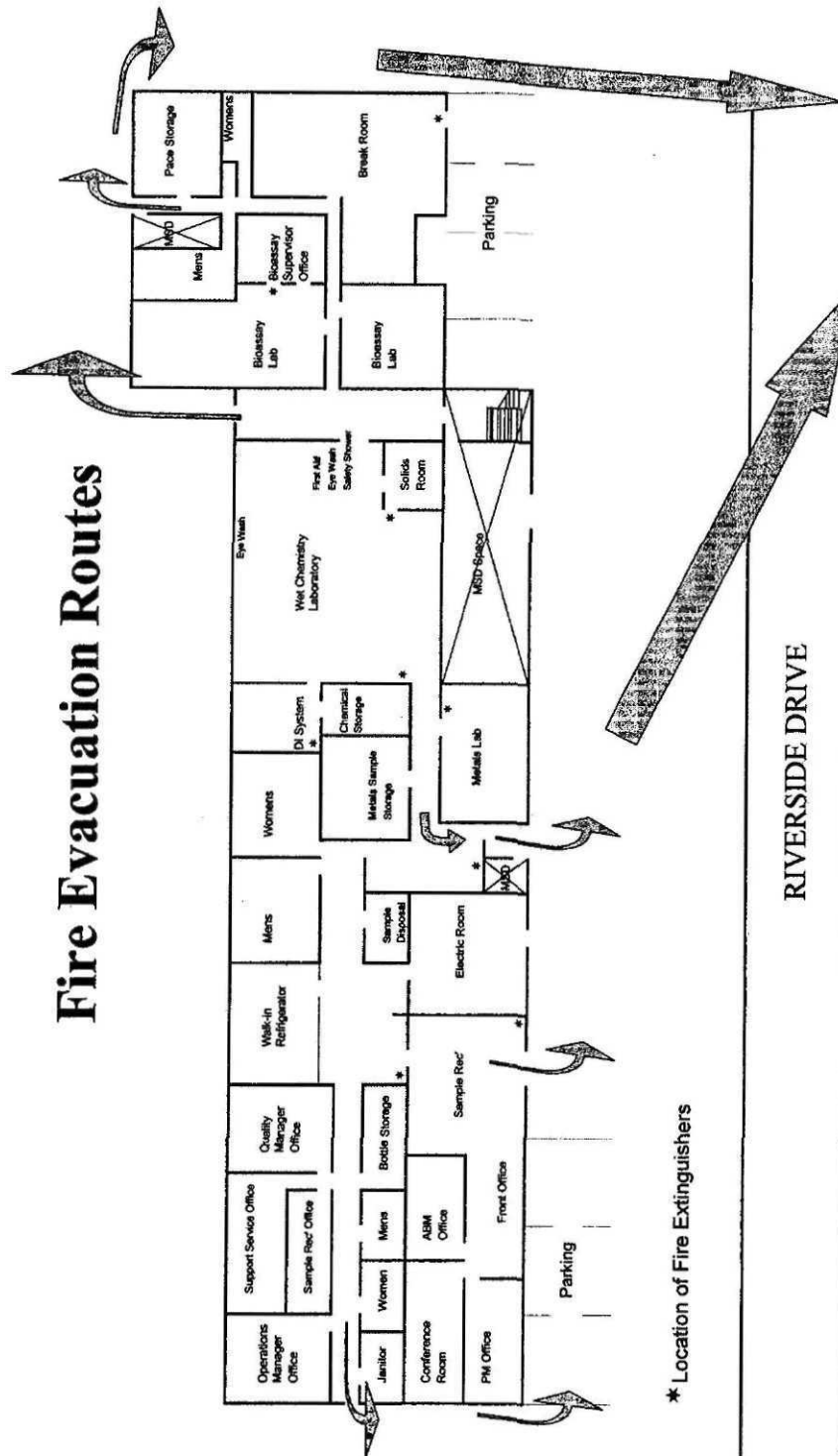
ATTACHMENT III- PASI-EDEN EQUIPMENT LIST


CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-EDN QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.

Department	Equipment	Model	Vendor	Serial Number	Analysis
Wet Chem	Refrigerator	CTX17KAB	Hotpoint	HV776598	Storage
Wet Chem	Refrigerator	CTX17	Hotpoint	RT733500	Ice Packs
Wet Chem	BOD Incubator	307	Fisher		BOD
Wet Chem	Air Incubator	4	Precision	22AJ-11	Total Coliform
Wet Chem	Air Incubator	1545	VWR	901391	Total Coliform
Wet Chem	Water Bath	GP400	Neslab	44.5 C	Fecal Coliform
Wet Chem	Autoclave	STM-F	Market Forge	120 208 240	Sterilization
Wet Chem	Oven	3510FS	Fisher	1879070501400	Solids
Wet Chem	Quanti-Tray	2X	Idexx	4518	Ecoli
Wet Chem	DO Meter	YSI5100	YSI	00K0582	BOD
Wet Chem	Spec/Colors	DR2800	Hach	1207494	Colors
Wet Chem	Turbidimeter	2020E	Lamotte	SN-ME12981	Turbidity
Wet Chem	Chlorine meter	Colorimeter	Hach	1230128764	Chlorine
Wet Chem	Vacuum	SA55NXGTE	Emerson	L87 7	Fecal Coliform
Wet Chem	Hotblock/Stirer		Fisher	803N0752	Fecal Coliform
Wet Chem	Nitrate Meter	720A+	Thermo Orion	92569	Nitrate
Wet Chem	Analytical Balance	A-160	Denver Instrument	N0090021	Fecal Coliform
Wet Chem	UV 365 nm	UVL-56	Blak-Ray	C22.2	Total Coliform
Wet Chem	Ion Meter	AP5	Fisher		PH
Wet Chem	Ion Meter	AP61	Fisher		PH & Temp
Wet Chem	Fume Hood	Safeaire	Hamilton	NA	
Wet Chem	Refrigerator	R-55-ST	Migali	1192185	Sample Receiving
Wet Chem	BOD Incubator	Isotemp	FisherScientific	NA	BOD
Wet Chem	PH meter	420A	Orion	8759	pH
Wet Chem	BOD Waterbath	VOLTS	Precision	9301-02	BOD
Wet Chem	TSS Desiccator				TSS
Field	Chlorine meter	Pocket Colorimeter	Hach		Chlorine

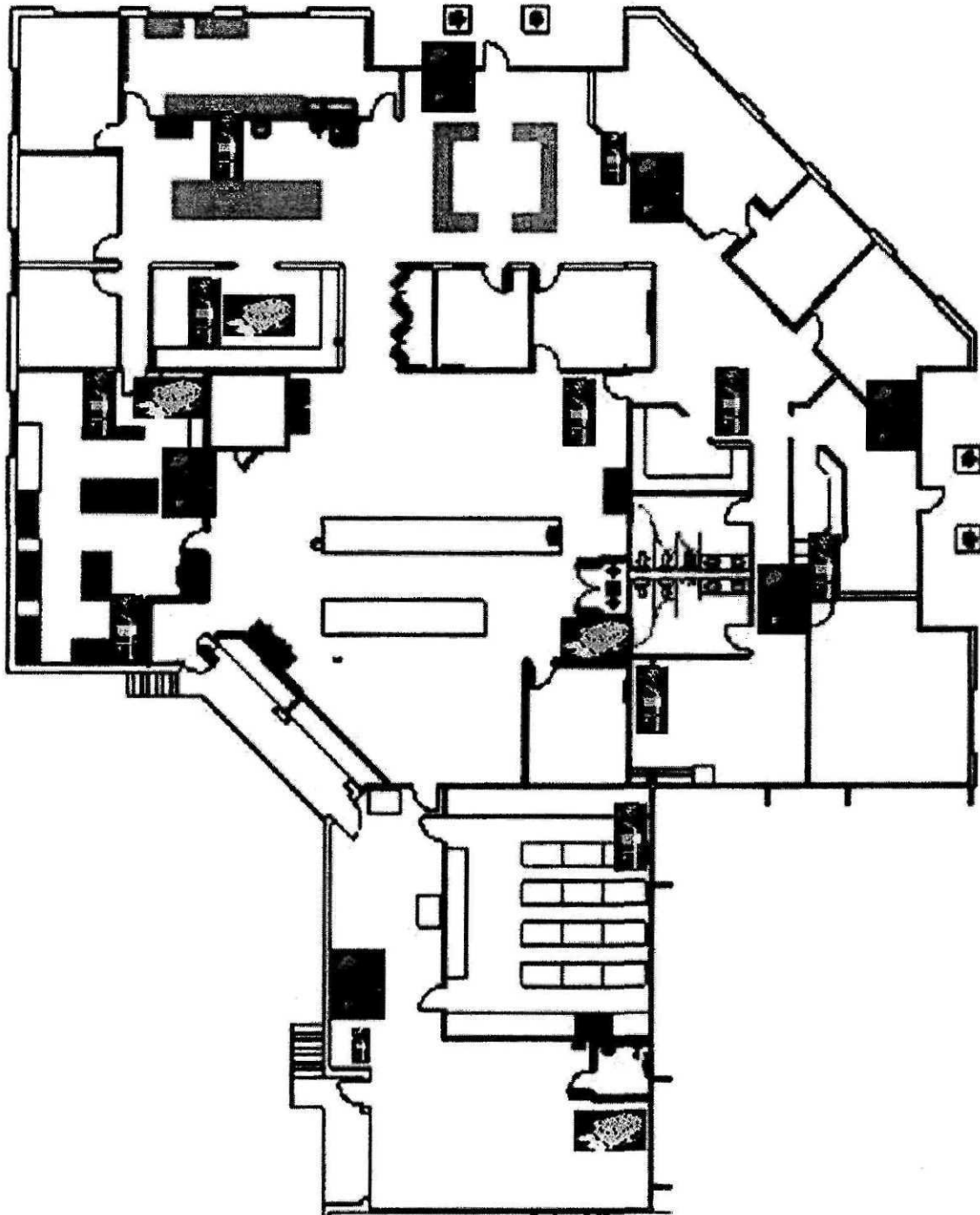
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ATTACHMENT IV- PASI-ASHEVILLE LABORATORY FLOOR PLAN
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ATTACHMENT IV- PASI-CHARLOTTE LABORATORY FLOOR PLAN
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ATTACHMENT V- PASI-ASHEVILLE LABORATORY SOP LIST

CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-AVL QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.

Title	Method	SOP Number	Revision
Alkalinity, Titrimetric	SM 2320 B	ASV-I-002	01
Ammonia by Konelab Analysis, Colorimetry	EPA 350.1 Rev. 2	ASV-I-003	01
Biochemical Oxygen Demand (BOD)	SM 5210 B	ASV-I-004	01
Chemical Oxygen Demand (COD) in Water, Wastwaters and Industrial Wastes	SM 5220D	ASV-I-005	01
Chloride by Konelab	SM 4500 Cl E	ASV-I-006	02
Color	SM 2120 B	ASV-I-008	01
Determination of Total Cyanide	SM 4500 CN E	ASV-I-009	01
Fecal Coliform	SM 9222 D	ASV-I-011	01
Ferrous Iron	SM 3500-FC (Modified)	ASV-I-012	00
Flash Point - Pensky Martens Closed Cup	SW-846 1010	ASV-I-013	00
Fluoride	SM 4500 F C	ASV-I-014	01
Glassware Washing	NA	ASV-I-015	01
Hardness, Calculation	SM2340B	ASV-I-016	01
Hexavalent Chromium in Water, Wastewater, and Soil	SM 3500 Cr D	ASV-I-017	01
Kjeldahl Nitrogen in water and wastes by Flow Injection Colorimetry	351.2	ASV-I-018	01
Mercury by Cold Vapor for Waters and Solids	245.1 / 7470A / 7471A	ASV-M-020	03
The Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry	EPA 353.2 (2.0)	ASV-I-021	01
Nitrite by Konelab Analysis	EPA 353.2	ASV-I-022	01
Ortho Phosphorus	EPA 365.1	ASV-I-023	01
Paint Filter Liquids Test	9095A	ASV-I-024	01
Phenols	420.4	ASV-I-025	02
pH	SM 4500 / SM 9045B	ASV-I-026	05
Settleable Solids	SM 2540 F	ASV-I-028	01
Specific Conductivity	EPA 120.1 Rev 4	ASV-I-029	2
Measurement of Solids in Water and Wastewater	SM 2540 B,C,&D	ASV-I-030	03
Sulfate by Konelab	ASTM D516- 90	ASV-I-031	01
Sulfide	376.2	ASV-I-032	02
TCLP	SW-864 1311	CAR-O-001	2
Total Coliform, Colilert	SM 9223 B	ASV-I-034	01
Total Organic Carbon (TOC)	SM 5310B	ASV-I-035	01
Total Phosphorus in Water by Konelab	EPA 365.1	ASV-I-036	01
Turbidity	EPA 180.1 Rev. 2.0	ASV-I-037	01
Anions by Ion Chromatography	EPA 300.0	ASV-I-58	00

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Title	Method	SOP Number	Revision
ICP	200.7	ASV-I-038	02
ICP	6010C	ASV-I-043	02
ICP 200.5	200.5	S-ASV-M-047	00
Total Residual Chlorine	SM 4500 Cl G	S-ASV-I-044	00
Heterotrophic Plate Count	IDEXX SimPlate	S-ASV-I-046	00
Tox Sop		S-ASV-B-049	00
Chronic Toxicity, Static Renewal, NC C.Dubia		S-ASV-B-050	00
Chronic Toxicity, Static Renewal, C.Dubia		S-ASV-B-051	00
Chronic Toxicity, Static Renewal, P.promelas		S-ASV-B-052	00
Definitive Acute Toxicity, P.promelas		S-ASV-B-053	00
Pass / Fail Acute Toxicity		S-ASV-B-054	00
Ceriodaphnia dubia culturing		S-ASV-B-055	00
Brine Shrimp		S-ASV-B-056	00
Light intensity and photoperiod.		S-ASV-B-057	00
Aquatic Tox. App.		S-ASV-B-058	00
Ion Chromatography	EPA 300.0	S-ASV-I-058	00
Kjeldahl Nitrogen in water and wastes by Flow Injection Colorimetry	EPA 351.2	S-ASV-I-059	00
Determination of Phenolic compounds by Flow injection Analysis colorimetry	420.4	S-ASV-I-060	00
Determination of Ortho Phosphate in waters by Flow injection analysis	EPA 365.1	S-ASV-I-061	00
Determination of Total Phosphorus by Injection Analysis - Lachat Method	EPA 365.1	S-ASV-I-062	00
Determination of Total Cyanide	SM 4500 CN E	S-ASV-I-063	00
Chloride by Lachat	SM 4500 Cl E	S-ASV-I-064	00
ASH		S-ASV-I-065	00
BTU		S-ASV-I-066	00
Chlorine - TOX		S-ASV-I-067	00
Sulfur		S-ASV-I-068	00
Moisture		S-ASV-I-069	00

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ATTACHMENT V- PASI-CHARLOTTE LABORATORY SOP LIST

CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-CHR QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.

Title	Method	SOP Number	Revision
Waste Handling and Management		S-CHR-S-002	01
Waste Management Training Requirements		S-CHR-S-003	01
Sample Management		S-CAR-C-001	02
Subcontracting Samples		S-CAR-C-003	03
Bottle Preparation		S-CAR-C-001	02
Toxicity Characteristic Leaching Procedure (TCLP)	1311	CAR-O-001	02
Purchasing of Lab Supplies		S-CAR-Q-005	01
Receipt and Storage of Laboratory Supplies		S-CAR-Q-006	03
Waste Water Sampling		S-CHR-F-001	03
Measuring Temperature in the Field	SM2550B	NC1-F-008	B
Measuring Total Residual Chlorine in the Field	SM4500 CI G	NC1-F-009	B
Handling and Storage of Radioactive Materials		S-CHR-L-001	02
Measurement of Percent Moisture in Soils and Solids	SM2540G	S-CHR-L-005	01
Fecal Coliforms	SM9222D	S-CHR-MB-001	02
Total Coliforms, Absent/Present	SM9223	S-CHR-MB-002	04
Cleaning Glassware for Organic Analyses		S-CHR-O-001	03
Extraction of Pesticides and PCBs from Solids	3546	S-CHR-O-002	03
The Extraction of PCBs from Oils	3580	S-CHR-O-004	02
Waste Dilution of Non-Aqueous Samples for GC/MS Analysis by 8270	3580	CHR-O-005	01
Extraction of Semi-Volatile Organics from Liquid Samples for GC/MS Analysis	3510C, 3535, 625	S-CHR-O-007	01
The Extraction of Diesel Range Organics and Oil Range Organics from Solids	3546	S-CHR-O-010	03
The Extraction of Diesel Range Organics and Oil Range Organics from Liquids	3510C, 3535	S-CHR-O-011	03
Determination of Semi-Volatile Organic Compounds in Aqueous Samples by GC/MS	625	S-CHR-O-013	02
Determination of Semi-Volatile Organic Compounds in Aqueous, Solid or Waste Samples by GC/MS	8270D	CHR-O-014	04
EDB, DBCP, TCP	504.1	CHR-O-019	01
Determination of EDB, DBCP and TCP in Water by Microextraction	8011	CHR-O-020	04
Determination of Diesel Range Organics by GC	8015C	CHR-O-021	02
Determination of Volatile Organic Compounds by GC/MS	8260B	S-CHR-O-023	06
Determination of Volatile Organic Compounds by GC/MS	624	CHR-O-024	02
Determination of Trihalomethanes by GC/MS	524.2	CHR-O-025	01
Oil and Grease Water	1664A	S-CHR-O-031	05
n-Hexane Extractable Material (HEM) for Sediment and Soil Samples	9071B	S-CHR-O-032	03
Determination of Haloacetic Acids	552.2	CHR-O-033	01
Determination of Gasoline Range Organics in Water and Soil	5030B, 8015C	CHR-O-040	03
The Extraction of Semi-Volatile Organics from Solid Samples in Preparation for GC/MS Analysis by Method 8270	3546	S-CHR-O-041	03

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Title	Method	SOP Number	Revision
The Extraction of Pesticides/PCBs from Liquid Samples in Preparation for GC Analysis by Methods 8081, 8082, and 608	3535, 608	S-CHR-O-043	03
The Extraction of Pesticides/PCBs from Non-Aqueous Waste Samples	3580	CHR-O-044	01
The Extraction of Semivolatiles from Wipes	3580 (modified)	S-CHR-O-045	01
Determination of Polychlorinated Biphenyls by GC	8082A, 608	CHR-O-046	03
Determination of Organochlorine Pesticides	8081B, 608	CHR-O-047	02
The Determination of 1,4-Dioxane in Aqueous Samples by GC/MS SIM Analysis Utilizing Isotope dilution	8270 SIM	S-CHR-O-048	02
Determination of Semivolatile Organics by GC/MS-SIM, Selective Ion Monitoring	8270 SIM	CHR-O-052	02
Determination of Volatile Organic Compounds by GC/MS	6200B 20thED	CHR-O-053	00
Determination of VPH in Water and Soil	MADEP VPH	CHR-O-054	01
The Determination of Extractable Petroleum Range Hydrocarbons by Gas Chromatography	MADEP EPH	S-CHR-O-055	00
The Extraction of Extractable Petroleum Range Hydrocarbons (EPH) from Solids	3546	S-CHR-O-056	00
The Extraction of Extractable Petroleum Range Hydrocarbons (EPH) from Liquids	3510C, 3535	S-CHR-O-057	00
Reporting Unacceptable Sample Preservation to North Carolina Department of Environment and Natural Resources		CHR-Q-001	01
Handling and Reporting Results of Drinking Water Samples		NC1-ALL-002	00
Measuring Dissolved Oxygen in the Field	SM 4500 O G	S-CHR-F-002	00
Measuring pH in the Field	SM4500H	NC1-F-002	C
Measuring Specific Conductivity in the Field	EPA 120.2, SM2510B	S-CHR-F-003	00
Determination of Oil Range Organics by Gas Chromatography	8015C	S-CHR-O-058	00
Clean Sampling for Ultratrace Metals	EPA 1669	S-CHR-F-004	00

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ATTACHMENT V- PASI-EDEN LABORATORY SOP LIST

CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-EDN QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.

Title	Method	SOP Number	Revision
Color ADMI	SM 2120 E	EDN-I-001	00
E. coli - Quanti-Tray	SM 9223 B QT	EDN-I-002	00
E. coli - Quanti-Tray	SM 9223 B QT	EDN-I-002	01
Fecal Coliform	SM 9222 D	EDN-I-003	00
Dissolved Oxygen, Field	SM 4500 O G	EDN-I-004	00
Hexavalent Chromium	SW846-7196A, SM 3500-Cr D	EDN-I-005	00
pH	SM 4500 H+ B	EDN-I-006	01
Settleable Solids	SM 2540 F	EDN-I-007	00
Total Coliform	SM 9223 B Colilert	EDN-I-008	00
Total Suspended Solids (TSS)	SM 2540-D	EDN-I-009	00
Turbidity	SM 2130 B	EDN-I-010	00
BOD	SM5210	EDN-I-011	00
Nitrate-N	SM4500 NO3 D	EDN-I-012	00
Glassware Washing SOP	SM5910 B	EDN-I-013	00

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ATTACHMENT VI- PASI-ASHEVILLE LABORATORY CERTIFICATION LIST
CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-AVL QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.


State	Accrediting Agency	Program	Certification Number
Connecticut	DPH	WW / HZ	PH-0106
Florida	DOH - NELAC	DW / WW / HZ	E87648
Massachusetts	DEP	WW	M-NC030
North Carolina	DENR	WW / HZ	40
North Carolina	DPH	DW	37712
Pennsylvania	DEP	WW / HZ	68-03578
South Carolina	DHEC	DW / WW / HZ	99030001
Virginia	DGS	DW	00072
West Virginia	DEP	WW / HZ	356

DW = Drinking Water

WW = Waste

Water

HW = Solid and Hazardous Waste

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ATTACHMENT VI- PASI-CHARLOTTE LABORATORY CERTIFICATION LIST
CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-CHR QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.


State	Accrediting Agency	Program	Certification Number
Connecticut	DPH	DW / WW / HZ	PH-0104
Florida	DOH - NELAC	DW / WW / HZ	E87627
Kentucky	DEP	WW / HZ	84
Louisiana	DEQ	WW / HZ	89654
North Carolina	DENR	WW / HZ	12
North Carolina	DHHS	DW	37706
North Carolina	DENR	Field	5342
New Jersey	DEP	WW / HZ	NC012
South Carolina	DHEC	WW / HZ	99006001
Virginia	DGS	DW	00213
West Virginia	DEP	WW / HZ	357

DW = Drinking Water

WW = Waste

Water

HW = Solid and Hazardous Waste

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ATTACHMENT VI- PASI-EDEN LABORATORY CERTIFICATION LIST


CURRENT AS OF ISSUE DATE OF QAM. CONTACT THE PASI-EDN QUALITY DEPARTMENT FOR AN UP-TO-DATE VERSION.

State	Accrediting Agency	Program	Certification Number
North Carolina	DPH	DW	37738
North Carolina	DENR	WW	633
Virginia	DGS	DW	00424
Virginia	DGS / VELAC	DW / WW	546

DW = Drinking Water

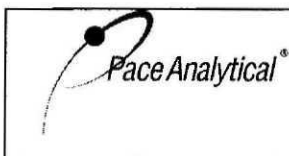
WW = Waste Water

HW = Solid and Hazardous Waste


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ATTACHMENT VIII- METHOD HOLD TIME, CONTAINER AND PRESERVATION GUIDE
(current as of issue date)


Parameter	Method	Matrix	Container	Preservative	Max Hold Time
2, 3, 7, 8-TCDD	1613B	Soil	8oz Glass	None	90/40 Days
2, 3, 7, 8-TCDD	1613B	Water	1L Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	90/40 Days
2, 3, 7, 8-TCDD	8290	Water	1L Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	30/45 Days
Acidity	SM2310B	Water	Plastic/Glass	≤6°C	14 Days
Alkalinity	SM2320B/310.2	Water	Plastic/Glass	≤6°C	14 Days
Alpha Emitting Radium Isotopes	9315/903.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Anions by IC, including Br, Cl, F, NO ₂ , NO ₃ , SO ₄	300.0/300.1/ SM4110B	Water	Plastic/Glass	≤6°C	Br, Cl, F, SO ₄ (28 Days) NO ₂ , NO ₃ (48 Hours)
Anions by IC, including Br, Cl, F, NO ₂ , NO ₃ , SO ₄	300.0/9056	Soil	Plastic/Glass	≤6°C	Br, Cl, F, SO ₄ (28 Days) NO ₂ , NO ₃ (48 Hours)
Aromatic and Halogenated Volatiles	8021	Soil	5035 vial kit	See 5035 note*	14 days
Aromatic and Halogenated Volatiles	601/602/8021	Water	40mL vials	pH<2 HCl; ≤6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days
Acid Volatile Sulfide	Draft EPA 1629	Soil	8oz Glass	≤6°C	14 Days
Bacteria, Total Plate Count	SM9221D	Water	Plastic/WK	≤6°C; Na ₂ S ₂ O ₃	24 Hours
Base/Neutrals and Acids	8270	Soil	8oz Glass	≤6°C	14/40 Days
Base/Neutrals and Acids	625/8270	Water	1L Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Base/Neutrals, Acids & Pesticides	525.1/525.2	Water	1L Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	7/30 Days
BOD/cBOD	SM5210B	Water	Plastic/Glass	≤6°C	48 hours
BTEX/Total Hydrocarbons	TO-3	Air	Summa Canister	None	14 Days
BTEX/Total Hydrocarbons	TO-3	Air	Tedlar Bag	None	48 Hours
Cation/Anion Balance	SM1030E	Water	Plastic/Glass	None	None
Chloride	SM4500Cl/9250/ 9251/9252	Water	Plastic/Glass	None	28 Days
Chlorinated Herbicides	8151	Soil	8oz Glass Jar	≤6°C	7/40 Days
Chlorinated Herbicides	8151	Water	1L Amber Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Chlorinated Herbicides	515.1	Water	1L Amber Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	14/28 Days
Chlorine, Residual	SM4500Cl	Water	Plastic/Glass	None	15 minutes




Parameter	Method	Matrix	Container	Preservative	Max Hold Time
COD	SM5220C/ 410.3/410.4	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤6°C	28 Days
Color	SM2120B,C,E	Water	Plastic/Glass	≤6°C	48 Hours
Condensable Particulate Emissions	EPA 202	Air	Solutions	None	6 Months
Cyanide, Reactive	SW846 chap.7	Water	Plastic/Glass	None	28 Days
Cyanide, Total and Amenable	SM4500CN/9010/ 9012/335.4	Water		pH>12 NaOH; ≤6°C; ascorbic acid if Cl present	14 Days, 24 Hours if Sulfide present
Diesel Range Organics-TPH DRO	8015	Soil	8oz Glass Jar	≤6°C	14/40 Days
Diesel Range Organics-TPH DRO	8015	Water	1L Glass	≤6°C	7/40 Days
Diesel Range Organics (WI)	WI MOD DRO	Soil	8oz Glass Jar	≤6°C	10/47 Days
Diesel Range Organics (WI)	WI MOD DRO	Water	1L Glass	≤6°C	14/40 Days
Dioxins & Furans	TO-9	Air	PUF	None	30/45 Days
EDB & DBCP	504.1/8011	Water	40mL vials	≤6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days
Explosives	8330/8332	Water	1L Glass	≤6°C	7/40 Days
Explosives	8330/8332	Soil	8oz Glass Jar	≤6°C	14/40 Days
Fecal Coliform	SM9222D	Water	100mL Plastic	≤6°C	6 Hours
Fecal Coliform	SM9222D	Soil	100mL Plastic	≤6°C	6 Hours
Ferrous Iron	SN3500Fe-D	Water	Glass	None	Immediate
Flashpoint/Ignitability	1010/1030	Water	Plastic/Glass	None	28 Days
Fluoride	SM4500Fl-C,D	Water	Plastic	None	28 Days
Gamma Emitting Radionuclides	901.1	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Gas Range Organics	8015	Water	40mL vials	pH<2 HCl	14 Days
Gasoline Range Organics	8015	Soil	5035 vial kit	See 5035 note*	14 days
Gross Alpha (NJ 48Hr Method)	NJAC 7:18-6	Water	Plastic/Glass	pH<2 HNO ₃	48 Hrs
Gross Alpha and Gross Beta	9310/900.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Haloacetic Acids	552.1/552.2	Water	40mL Amber vials	NH ₄ Cl; ≤6°C	14/7 Days
Hardness, Total (CaCO ₃)	SM2340B,C/130.1	Water	Plastic/Glass	pH<2 HNO ₃	6 Months
Heterotrophic Plate Count (MPC)	EPA 9215B	Water	100mL Plastic	≤6°C	24 Hours
Hexavalent Chromium	7196/218.6/ SM3500Cr	Water	Plastic/Glass	≤6°C	24 Hours
Hydrogen Halide & Halogen Emissions	EPA 26	Air	Solutions	None	6 Months
Lead Emissions	EPA 12	Air	Filter/Solutions	None	6 Months
Low Level Mercury	1631	Water	Glass	BrCl	90 days (if preserved and oxidized)
Mercury	7471	Soil	8oz Glass Jar	≤6°C	28 days

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Mercury	7470/245.1/245.2	Water	Plastic/Glass	pH<2 HNO ₃	28 Days
Metals	7300/7303	Air	Filters	None	6 Months
Metals (and other ICP elements)	6010	Soil	8oz Glass Jar	None	6 months
Metals (and other ICP elements)	6010/6020/200.7/ 200.8	Water	Plastic/Glass	pH<2 HNO ₃	6 Months
Methane, Ethane, Ethene	EPA Mod 8015	Water	40mL vials	HCl	14 Days
Methane, Ethane, Ethene	RSK-175	Water	40mL vials	HCl	14 Days
Methane, Ethane, Ethene	EPA 3C	Air	Summa Canister	None	14 Days
Methane, Ethane, Ethene	EPA 3C	Air	Tedlar Bag	None	48 Hours
Methanol, Ethanol	EPA 8015	Water	40mL vials	<6°C	14 Days
Methanol, Ethanol	EPA 8015	Soil	2oz Glass	<6°C	14 Days
Nitrogen, Ammonia	SM4500NH3/350.1	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; <6°C	28 Days
Nitrogen, Kjeldahl	SM4500-Norg; 351.1/351.2	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; <6°C	28 Days
Nitrogen, Nitrate	SM4500-NO3/ 352.1	Water	Plastic/Glass	<6°C	48 Hours
Nitrogen, Nitrate & Nitrite	SM4500-NO3/ 353.2	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; <6°C	28 Days
Nitrogen, Nitrite	SM4500-NO2/ 353.2	Water	Plastic/Glass	<6°C	48 Hours
Nitrogen, Organic	SM4500-Norg/ 351.2	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; <6°C	28 Days
Non-Methane Organics	EPA 25C	Air	Summa Canister	None	14 Days
Non-Methane Organics	EPA 25C	Air	Tedlar Bag	None	48 Hours
Odor	SM2150B	Water	Glass	<6°C	24 Hours
Oil and Grease/HEM	1664A/SM5520B/ 9070	Water	Glass	pH<2 H ₂ SO ₄ ; <6°C	28 Days
Organochlorine Pesticides & PCBs	TO-4	Air	PUF	None	7/40 Days
Organochlorine Pesticides & PCBs	8081/8082/608	Water	1L Glass	<6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Organochlorine Pesticides & PCBs	8081/8082	Soil	8oz Glass Jar	<6°C	14/40 Days
Organophosphorous Pesticides	8141	Soil	8oz Glass Jar	<6°C	14/40 Days
Organophosphorous Pesticides	8141	Water	1L Amber Glass	<6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Oxygen, Dissolved (Probe)	SM4500-O	Water	Glass	None	15 minutes
Paint Filter Liquid Test	9095	Water	Plastic/Glass	None	N/A
Particulates	PM-10	Air	Filters	None	6 Months
Permanent Gases	EPA 3C	Air	Summa Canister	None	14 Days
Permanent Gases	EPA 3C	Air	Tedlar Bag	None	48 Hours

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
pH	SM4500H+B/9040/ 9041/150.2	Water	Plastic/Glass	None	15 minutes
Phenol, Total	420.1/420.4/9065/ 9066	Water	Glass	pH<2 H ₂ SO ₄ ; ≤6°C	28 Days
Phosphorus, Orthophosphate	SM4500P/365.1/365.3	Water	Plastic	Filter; ≤6°C	Filter within 15 minutes, Analyze within 48 Hours
Phosphorus, Total	SM4500P/ 365.1/365.3/365.4	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤6°C	28 Days
Phosphorus, Total	EPA 365.4	Soil	Plastic/Glass	≤6°C	28 Days
Polynuclear Aromatic Hydrocarbons	TO-13	Air	PUF	None	7/40 Days
Polynuclear Aromatic Hydrocarbons	8270 SIM	Soil	8oz Glass Jar	≤6°C	14/40 Days
Polynuclear Aromatic Hydrocarbons	8270 SIM	Water	1L Glass	≤6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Radioactive Strontium	905.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Radium-226 Radon Emanation Technique	903.1	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Radium-228	9320/904.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Silica, Dissolved	SM4500Si-D	Water	Plastic	≤6°C	28 Days
Solids, Settleable	SM2540F	Water	Glass	≤6°C	48 Hours
Solids, Total	SM2540B	Water	Plastic/Glass	≤6°C	7 Days
Solids, Total (FOC)	ASTM D2974	Soil	Plastic/Glass	≤6°C	7 Days
Solids, Total Dissolved	SM2540C	Water	Plastic/Glass	≤6°C	7 Days
Solids, Total Suspended	SM2540D	Water	Plastic/Glass	≤6°C	7 Days
Solids, Total Volatile	SM2540E	Water	Plastic/Glass	≤6°C	7 Days
Specific Conductance	SM2510B/9050/120.1	Water	Plastic/Glass	≤6°C	28 Days
Stationary Source Dioxins & Furans	EPA 23	Air	XAD Trap	None	30/45 Days
Stationary Source Mercury	EPA 101	Air	Filters	None	6 Months, 28 Days for Hg
Stationary Source Metals	EPA 29	Air	Filters	None	6 Months, 28 Days for Hg
Stationary Source PM10	EPA 201A	Air	Filters	None	6 Months
Stationary Source Particulates	EPA 5	Air	Filter/Solutions	None	6 Months
Sulfate	SM4500SO4/9036/ 9038/375.2/ASTMD516	Water	Plastic/Glass	≤6°C	28 Days
Sulfide, Reactive	SW-846 Chap.7	Water	Plastic/Glass	None	28 Days
Sulfide, Total	SM4500S/9030	Water	Plastic/Glass	pH>9 NaOH; ZnOAc; ≤6°C	7 Days
Sulfite	SM4500SO3	Water	Plastic/Glass	None	15 minutes
Surfactants	SM5540C	Water	Plastic/Glass	≤6°C	48 Hours

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Total Organic Carbon (TOC)	SM5310B,C,D/ 9060	Water	Glass	pH<2 H ₂ SO ₄ or HCl; ≤6°C	28 Days
Total Organic Halogen (TOX)	SM5320/9020/ 9021	Water	Glass; no headspace	≤6°C	14 Days
Tritium	906.0	Water	Glass	pH<2 HNO ₃	180 days
Turbidity	SM2130B/180.1	Water	Plastic/Glass	≤6°C	48 Hours
Uranium Radiochemical Method	908.0/ASTM D5174-97	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Volatiles	TO-14	Air	Summa Canister	None	30 Days
Volatiles	TO-14	Air	Tedlar Bag	None	48 Hours
Volatiles	TO-15	Air	Summa Canister	None	30 Days
Volatiles	8260	Soil	5035 vial kit	See 5035 note*	14 days
Volatiles	8260	Water	40mL vials	pH<2 HCl; ≤6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days
Volatiles	8260	Conc. Waste	5035 vial kit or 40mL vials	≤6°C	14 Days
Volatiles	624	Water	40mL vials	pH<2 HCl; ≤6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days (7 unpreserved)
Volatiles	524.1/524.2	Water	40mL vials	pH<2 HCl; ≤6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days
Alaska DRO	AK102	Soil	8oz Glass	≤6°C	14/40 Days
Alaska DRO	AK102	Water	1L Glass	pH<2 HCl; ≤6°C	14/40 Days
Alaska RRO	AK103	Soil	8oz Glass	≤6°C	14/40 Days
Alaska GRO	AK101	Soil	5035 vial kit	See 5035 note*	14 Days
Alaska GRO	AK101	Water	40mL vials	pH<2 HCl; ≤6°C	14 Days

5035 Note: 5035 vial kit typically contains 2 vials water, preserved by freezing **or**, 2 vials aqueous sodium bisulfate preserved at 4°C, **and** one vial methanol preserved at ≤6°C **and** one container of unpreserved sample stored at ≤6°C.

APPENDIX C

EXAMPLE FIELD DATA RECORDS



FIELD INSTRUMENT CALIBRATION RECORD

FIELD INSTRUMENT CALIBRATION RECORD

Project Name: CTS of Asheville, Inc. Superfund Site

Date: _____

Project Number: _____

Name: _____

Water Quality Meter Calibration

	<u>Standard Value</u>	<u>Meter Value</u>	<u>Acceptance Criteria</u>
Manufacturer: _____	pH: _____ SU	pH: _____ SU	+/- 10% of standard
Model No.: _____	Conductivity: _____ mS/cm	Conductivity: _____ mS/cm	+/- 10% of standard
Unit ID: _____	Redox: _____ +/- mV	Redox: _____ +/- mV	see note 1
	DO: _____ mg/L *	DO: _____ mg/L	+/- 10% of standard
Thermometer Temperature: _____ C°		Temperature: _____ C°	+/- 2.0 C°

Turbidity Meter Calibration

	<u>Standard Value</u>	<u>Meter Value</u>	<u>Acceptance Criteria</u>
Manufacturer: _____	_____ NTU (low)	_____ NTU	+/- 10% of standard
Model No.: _____	_____ NTU (med)	_____ NTU	+/- 10% of standard
Unit ID: _____	_____ NTU (high)	_____ NTU	+/- 10% of standard

Photoionization Detector

			<u>Acceptance Criteria</u>
Manufacturer: _____	Background: _____ ppmv	Meter: _____ ppmv	within 5 ppmv of Zero
Model No.: _____	Span Gas: _____ ppmv	Meter: _____ ppmv	+/- 10% of standard
Unit ID: _____			

Calibration Sources

	<u>Source</u>	<u>Value</u>	<u>Lot Number</u>	<u>Expiration Date</u>
pH	_____	_____ SU	_____	_____
Conductivity	_____	_____ mS/cm	_____	_____
Redox:	_____	_____ mV	_____	_____
Turbidity (low)	_____	_____ NTU	_____	_____
Turbidity (med):	_____	_____ NTU	_____	_____
Turbidity (high):	_____	_____ NTU	_____	_____
PID gas:	_____	_____ ppmv	_____	_____
Other:	_____	_____	_____	_____

NOTES:

* = Indicate in notes section what was used as the DO standard (i.e., based on saturation at room temperature)

** = If the meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria

1 = meter must read within specified range of the Zobell solution (usually 231 +/- 10 mv).



WATER SUPPLY WELL SAMPLING RECORD

WATER SUPPLY WELL SAMPLING RECORD

Project Name: CTS of Asheville, Inc. Superfund Site

Project Number: _____

Sampler Name(s): _____

Well Address: _____

Sample ID: _____

Sample Date/Time: _____

QA/QC Samples: _____

Purge Start Time: _____

Volume Purged: _____ gallons (approximate)

Sample Location: _____

Time	pH	Temperature (°C)	Conductivity (mS/cm)	Turbidity (NTU)	Comments
initial					

If alternative units are indicated by meter, indicate the proper measurement units above.

°C - degrees Celcius; mS/cm - milliSiemens per centimeter; NTU - nephelometric turbidity units

Notes/Comments:



WATER SUPPLY SPRING SAMPLING RECORD

WATER SUPPLY SPRING SAMPLING RECORD

Project Name: CTS of Asheville, Inc. Superfund Site

Project Number: _____

Sampler Name(s): _____

Spring Address: _____ Sample ID: _____

Sample Date/Time: _____ QA/QC Samples: _____

Sample Location: _____

Time	pH	Temperature (°C)	Conductivity (mS/cm)	Turbidity (NTU)	Comments

If alternative units are indicated by meter, indicate the proper measurement units above.

°C - degrees Celcius; mS/cm - milliSiemens per centimeter; NTU - nephelometric turbidity units

Notes/Comments:



WATER SUPPLY MONITORING – SAMPLE SUMMARY FORM

WATER SUPPLY MONITORING - SAMPLE SUMMARY FORM

Project Name: CTS of Asheville, Inc. Superfund Site

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Project Number: _____

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